SCIENTIFIC AMERICAN

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THE NEW CHICAGO WATER WORKS—THE LAKE TUNNEL, INTAKES, AND CAISSONS.

Chicago has long been noted for its water works, drawing their supply from the inexhaustible reservoir of Lake Michigan. They have been termed one of the wonders of the world. On March 17, 1864, the work began on a tunnel to be carried out two miles into the lake in order to secure a pure supply. On December 6, 1866, the tunnel was finished, and water was first furnished to the city through it on March 25, 1867. The original tunnel was in brick, 62 inches high and 60 inches wide, lying from 66 to 70 feet below the surface of the water. As Chicago lies nearly on a plain, all city levels are referred to this point, the surface of the lake. It forms a plane of reference, and is termed the city datum. At the end of the tunnel a grated cylinder of iron was established, through which the water enters the tunnel. This intake, for further protection, was surrounded by a crib and breakwater. Subsequently a second tunnel, 84 inches in diameter, carried out to the same crib, was extended under the city, so as to give an independent supply to the southwestern quarter. The original pumping engines had a daily capacity of 73,000,000 gallons. The original tunnel could deliver 57,000,000 gallons in the same time. In addition to the lake supply of water, a number of artesian wells have been sunk, at depths varying from 650 to nearly 2,000 feet. The water from these wells is not of the purest, containing 70 grains of solid matter to the gal-

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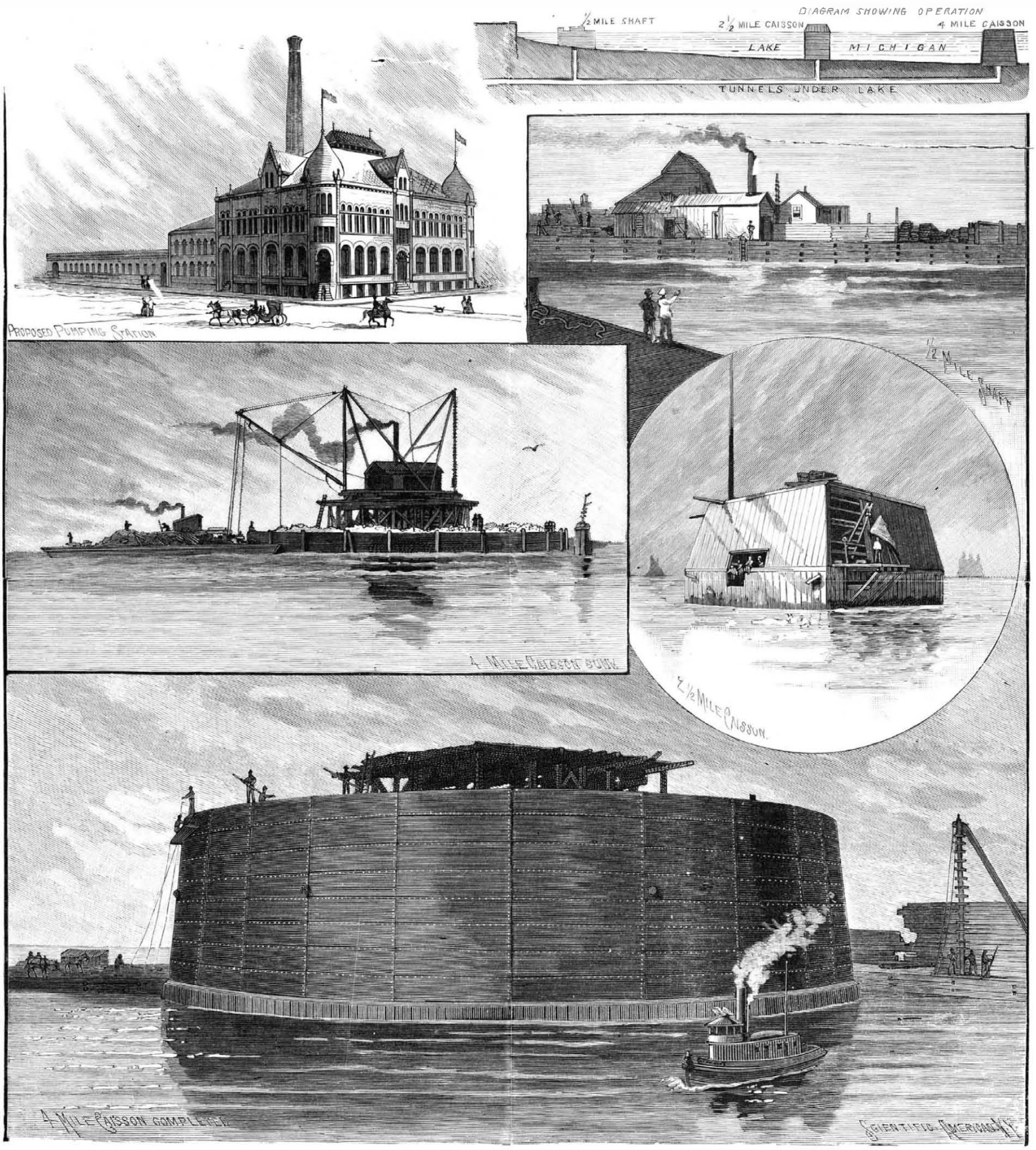

THE NEW CHICAGO WATER WORKS—THE LAKE TUNNEL. INTAKES. AND CAISSONS.

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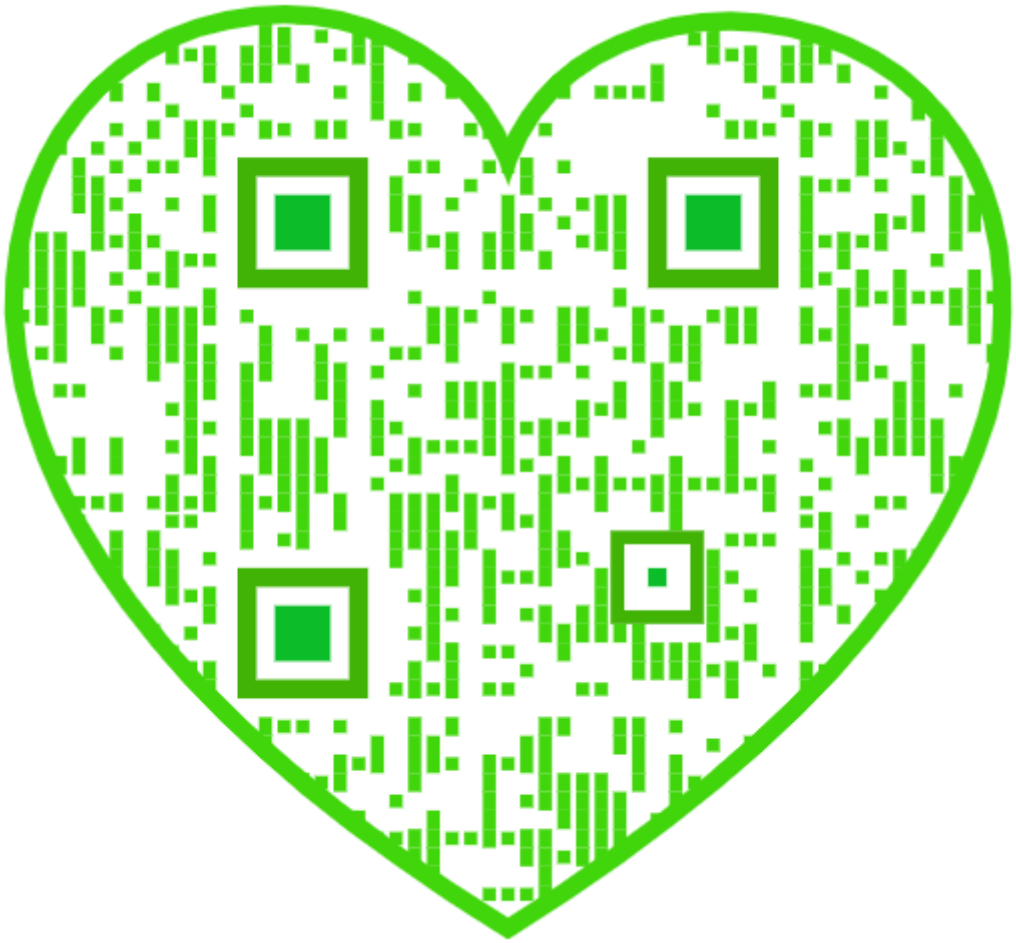

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THE SCIENTIFIC AMERICAN—EDICION ESPANOLA.

In view of the enlarging commercial relations between the United States and the republics south of us, we have concluded to publish a regular edition of the SCIENTIFIC AMERICAN in the Spanish language, of which the first number will be issued in January, and thereafter monthly until a more frequent publication is required.

This beautiful tongue prevails throughout all the vast territories of Cuba, the Spanish West Indies, Mexico, Honduras, Guatemala, Nicaragua, San Salvador, Costa Rica, the United States of Colombia, the United States of Venezuela, Ecuador, Peru, Bolivia, Cbile, the Agentine Republic, Paraguay, Uruguay, and in part in the United States of Brazil—seventeen great countries, all enjoying with us the republican forms of government, allied to us by all the ties of neighborhood and political affinity, having in common with us the attainment of the same great objects, the promotion of industry, peace, and prosperity.

The States of Mexico, now provided with railways and joined to the vast railway system of this country, are already beginning to experience important benefits from this new connection. The industries of Mexico are commencing to flourish with a new vigor, her political and financial standing is becoming solidified, her population is increasing, and in all directions are seen the evidences of substantial improvement. The Tehuantepec railway and the canal of Nicaragua, from ocean to ocean, are now in process of construction. The railways are being extended southward through Mexico toward Panama, and from Chile and the Argentines northward toward Bogota. All parts of America, North and South, will soon be joined together by iron highways, over which vast exchanges of passengers and products will be maintained.

Including the Americas, North and South, Cuba, Spain, and her colonial possessions, the Spanish-speaking peoples of the world number in the aggregate not less than seventy-five millions, and the landed area by them occupied reaches nine millions of square miles.

To all these peoples, printed in their own language, will the SCIENTIFIC AMERICAN go with its messages of knowledge and instruction. While for convenience of preparation its point of issue is in New York, its real home will be among the Spanish people wherever they dwell. Devoted to the spread of useful information, it will be welcome everywhere. By the facilities of the Postal Union, it can be received with almost the same regularity, and at as low a cost, as if it were printed in the town where the subscriber resides.

The first or introductory number of the SCIENTIFIC AMERICAN, Edicion Española, will have a great and unusually valuable circulation. Special copies are to be sent to influential persons in the principal towns and cities of all the countries above named, including the leading importing merchants, manufacturers and dealers in all kinds of machinery, to government officials, naval and military, railway directors, superintendents and master mechanics, civil, mechanical, and mining engineers, owners and superintendents of mines, millers, and machinists, wood workers, steam users, steam engineers, telegraph and electrical engineers, planters, etc. Leading people in the various branches of industry likely to be interested in the productions of American mechanical and manufacturing skill will be reached by this publication. Printed at the low rate of $3 a year, it will have by far the largest and most substantial circulation ever given in Spanish countries to such a periodical.

We shall reserve a limited space for the publication of manufacturing announcements, for which the terms will be very moderate. We need hardly say this opportunity for advertisers to make their productions known and thereby increase their foreign trade is a rare one. Advertisements intended for the first number should be sent in without delay.

ERICSSON'S PHYSICAL STRENGTH.

It is well known that the late Capt. Ericsson was of robust constitution and remarkable power of enduring continuous sedentary application; but it is not so well known that he was possessed of enormous physical strength. Of this he was not vain, nor was it often exerted; he husbanded his resources with jealous care, with a view to their expenditure in useful work. In one or two instances, however, his muscular power was displayed in a startling manner.

He was always very particular about the quality of both materials and workmanship, and on one occasion during the construction of an engine at Delamater's, a certain casting appearing to him doubtful as to soundness, he ordered it to be broken up. And possibly suspecting that blowholes might be plugged, or the suspected piece made to do duty in some way, he insisted on having it broken on the spot. Some stalwart workmen accordingly attacked it with heavy two-handed sledges, but, failing to make an impression, they desisted at length, saying: "We will put it under the drop by and by." His quick temper rose at this, but he spoke not a word; with his right hand he snatched the sledge from the nearest man, and in an instant it whirled like a meteor before the eyes of the astonished spectators, the ponderous tool driving its head at the first stroke through the shell of the dubious casting, making it a hopeless wreck. He tossed away the sledge as if it had been a jackstraw, and turning on his heel, strode away with the remark: "Now you *may* put it under the drop."

During one of his visits of inspection to the Monitor while she was building, he was annoyed by tripping once or twice over a heavy bar of iron. Turning to two workmen near at hand, he asked them to remove it; but they said it was too heavy. Nettled at this refusal, and as if in contempt for the excuse, he made no reply, but stooping, he picked up the bar with his own hands, carried it without assistance across the shop, and threw it on a scrap heap. The two men were amazed, as well they might be, to see a single man, already nearly sixty years of age, dealing in this summary way with a matter which they had not ventured to meddle with; they procured some assistance at noon time, and out of curiosity weighed the offending bar, which showed upon the scale nearly a third of a ton.

In the summer of 1871, the captain, accompanied by his secretary, on nearly every fine day used to cross the river to Hoboken, and take a stroll up around the "river walk," past the Sibyl's cave, and through the then pleasant, park-like region of the Elysian Fields. This exception to the rules of his ordinary daily routine was in accordance with the advice of his physician, who had been called in on account of certain pains in the small of his back, from which he had been suffering. And it is mentioned in this connection because Capt. Ericsson himself had been speculating upon the causes of these symptoms, which he persisted in attributing to the circumstance of over-exertion in his youth, particularly on one occasion when, at the age of 18, he had lifted six hundred pounds, thereby, as he thought, straining the muscles and laying the foundation for his trouble, though he had experienced no previous ill effect.

A Whale Breaks a Submarine Telegraph Cable.

On September 9th a fault broke out in the Santos-Santa Catharina section of the Western and Brazilian Telegraph Company's system of cables, but through which signals were exchanged up to the moment of cutting by the repairing steamer Viking. The latter, while engaged on the repair on October 17, picking up toward the fault in 57 fathoms, and about 70 miles north from Santa Catharina, brought to the surface a monster dead whale, measuring about 50 feet long, intact, with the exception of the upper part (the belly), from which all the skin had been worn or eaten away, leaving only a small portion on the neck and tail; the cable parted at the fault with the strain put upon it in lifting, and the carcass of the whale being relieved of the downward pressure, rose like a torpedo and inflated like a balloon, a portion on arriving at the surface of the water bursting and creating a most offensive odor, so that every one was thankful when the cable was cut, and the obnoxious object drifted to leeward; the tail of the whale had two complete turns round the shank and three or four across the flat or fan part. It would be interesting to know how long this creature had been thus imprisoned; from the advanced stage of decomposition it must have been there some considerable time; its body was covered with barnacles, and some even on the white part, where the skin had disappeared.

It is worthy of note that this cable was laid in 1874, and with the exception of one repair by the contractors in 1875, has never since been touched, and is as perfect as the day it was laid.

The above by Mr. Peters, of the Viking, is the third instance in which whales have broken telegraph cables. The first occurred in the Persian Gulf some fifteen years ago, and the second on the west coast of America, off the Peruvian coast, some seven years since. In both cases the whale was dead when brought to the surface by the repairing vessel, and was entangled in the cable. The supposed cause is that the cables were hung in festoons through being laid too tightly over uneven ground, and that the whales used them as rubbing posts to get rid of some of the barnacles with which their bodies are often covered. A swish of the tail can easily account for the cable being twisted round the body, and the weight and the struggles of the animal can easily account for the break. We are inclined to think the weight of the dead decomposing body is more likely to break the suspended bight than the swimming strength of the whale, which compared to the longitudinal strength of a cable must be a small matter. The peculiarity of the case off the Brazilian coast lies in the cable not being broken.—*Electrical Review.*

THE steamer City of Paris, of the Inman line, plying between New York and Liverpool, is of 10,500 tons burden, 18,000 horse power, and has maintained a mean speed of 23·73 miles per hour throughout the voyage of about 3,000 miles. She has 54 furnaces, and her boiler tubes exceed 13 miles in aggregate length.

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Stanley's Thrilling Record of African Exploration.

Henry M. Stanley, at the head of his exploration and relief expedition, which started up the Congo, on the West African coast, in March, 1887, arrived at Bagomoyo, near Zanzibar, on the east coast, Dec. 4, with Emin Pasha and his principal lieutenants and a considerable number of followers. The day following a serious, if not fatal, accident occurred to Emin, who, being near-sighted, misjudged the height of a balcony in a building where he was being banqueted, and fell a distance of twenty feet. This seems strikingly like a continuance of the fatalism or providence which Stanley appears to think has been a dominant factor with him throughout his last expedition, as set forth in his own words in the following thrilling record of peril, adventure, suffering, and endurance, which comes by cable to the *New York Herald*. He says:

First of all I am in perfect health, and feel like a laborer of a Saturday evening returning home with his week's work done, his week's wages in his pocket, and glad that to-morrow is the Sabbath.

Just about three years ago, while lecturing in New England, a message came to me under the sea bidding me to hasten and take a commission to relieve Emin Pasha at Wadelai; but, as people generally do with faithful pack-horses, numberless little trifles, odds and ends, are piled on over and above the proper burden. Twenty various little commissions were added to the principal one, each requiring due care and thought. Well, looking back over what has been accomplished, I see no reason for any heart's discontent. We can say we shirked no task, and that good will, aided by steady effort, enabled us to complete every little job as well as circumstances permitted.

Over and above the happy ending of our appointed duties we have not been unfortunate in geographical discoveries. The Aruwimi is now known from its source to its bourne. The great Congo forest, covering as large an area as France and the Iberian peninsula, we can now certify to be an absolute fact. The Mountains of the Moon this time, beyond the least doubt, have been located, and Ruwenzori, "the Cloud King," robed in eternal snow, has been seen, and its flanks explored, and some of its shoulders ascended, Mounts Gordon Bennett and Mackinnon cones being but giant sentries warding off the approach to the inner area of "the Cloud King." On the southeast of the range the connection between Albert Edward Nyanza and the Albert Nyanza has been discovered, and the extent of the former lake is now known for the first time. Range after range of mountains has been traversed, separated by such tracts of pasture land as would make your cowboys out West mad with envy. And right under the burning equator we have fed on blackberries and bilberries and quenched our thirst with crystal water fresh from snow beds. We have also been able to add nearly 6,000 square miles of water to Victoria Nyanza.

Our naturalist will expatiate upon the new species of animals, birds, and plants he has discovered. Our surgeon will tell what he knows of the climate and its amenities. It will take us all we know how to say what new store of knowledge has been gathered from this unexpected field of discoveries. I always suspected that in the central regions between the equatorial lakes something worth seeing would be found, but I was not prepared for such a harvest of new facts.

This has certainly been the most extraordinary expedition I have ever led into Africa. A veritable divinity seems to have hedged us while we journeyed. I say it with all reverence. It has impelled us whither it would, effected its own will, but nevertheless guided and protected us. What can you make of this, for instance? August 17, 1887, all the officers of the rear column are united at Yambuya. They have my letter of instructions before them, but instead of preparing for the morrow's march, to follow our track, they decided to wait at Yambuya, which decision initiates the most awful season any community of men ever endured in Africa or elsewhere. The results are that three-quarters of their force died of slow poison. Their commander is murdered, and the second officer dies soon after of sickness and grief. Another officer is wasted to a skeleton and obliged to return home. A fourth is sent to wander aimlessly up and down the Congo, and the survivor is found in such a fearful pest hole that we dare not describe its horrors.

On the same date, 150 miles away, the officer of the day leads 333 men of the advanced column into the bush, loses the path and all consciousness of his whereabouts, and every step he takes only leads him further astray. His people become frantic; his white companions, vexed and irritated by the sense of the evil around them, cannot devise any expedient to relieve him. They are surrounded by cannibals, and poison-tipped arrows thin their numbers. Meantime, I, in command of the river column, am anxiously searching up and down the river in four different directions; through forests my scouts are seeking for them, but not until the sixth day was I successful in finding them.

Taking the same month and the same date in 1888, a year later, on August 17, I listen, horror struck, to the tale of the last surviving officer of the rear column at Banalya, and am told of nothing but death and disaster, disaster and death, death and disaster. I see nothing but horrible forms of men smitten with disease, bloated, disfigured, and scarred, while the scene in the camp, infamous for the murder of poor Barttelot barely four weeks before, is simply sickening. On the same day, 600 miles west of this camp, Jameson, worn out with fatigue, sickness, and sorrow, breathes his last.

On the next day, August 18, 600 miles east, Emin Pasha and my officer, Jephson, are suddenly surrounded by infuriated rebels, who menace them with loaded rifles and instant death, but fortunately they relent and only make them prisoners, to be delivered to the Mahdists. Having saved Bonny out of the jaws of death, we arrive a second time at Albert Nyanza, to find Emin Pasha and Jephson prisoners in daily expectation of their doom.

Jephson's own letters will describe his anxiety. Not until both were in my camp and the Egyptian fugitives under our protection did I begin to see that I was only carrying out a higher plan than mine. My own designs were constantly frustrated by unhappy circumstances. I endeavored to steer my course as direct as possible, but there was an unaccountable influence at the helm.

I gave as much good will to my duties as the strictest honor would compel. My faith that the purity of my motive deserved success was firm, but I have been conscious that the issues of every effort were in other hands. Not one officer who was with me will forget the miseries he has endured, yet every one that started from his home destined to march with the advance column and share its wonderful adventures is here to-day safe, sound, and well, and the *Herald* correspondent may interview them to his heart's content. This is not due to me. Lieut. Stairs was pierced with a poisoned arrow like others, but others died, and he lives. The poisoned tip came out from under his heart eighteen months after he was pierced. Jephson was four months a prisoner, with guards with loaded rifles around him. That they did not murder him is not due to me.

These officers have had to wade through as many as seventeen streams and broad expanses of mud and swamp in a day. They have endured a sun that scorched whatever it touched. A multitude of impediments have ruffled their tempers and harassed their hours. They have been maddened with the agonies of fierce fevers. They have lived for months in an atmosphere that medical authority declared to be deadly. They have faced dangers every day, and their diet has been all through what legal serfs would have declared to be infamous and abominable, and yet they live.

This is not due to me any more than the courage with which they have borne all that was imposed upon them by their surroundings or the cheery energy which they bestowed to their work, or the hopeful voices which rang in the ears of a deafening multitude of blacks, and urged the poor souls on to their goal.

The vulgar will call it luck, unbelievers will call it chance, but deep down in each heart remains the feeling that of verity there are more things in heaven and earth than are dreamed of in common philosophy.

I must be brief. Numbers of scenes crowd the memory. Could one but sum them into a picture, it would have a grand interest. The uncomplaining heroism of our dark followers, the brave manhood latent in such uncouth disguise, the tenderness we have seen issuing from nameless entities, the great love animating the ignoble, the sacrifice made by the unfortunate for one more unfortunate, the reverence we have noted in barbarians, who, even as ourselves, were inspired with nobleness and incentives to duty—of all these we could speak if we would, but I leave that to the *Herald* correspondent, who, if he has eyes to see, will see much for himself, and who, with his gifts of composition, may present a very taking outline of what bas been done, and is now near ending, thanks be to God for ever and ever!

Yours faithfully,
HENRY M. STANLEY.

House Building at the West.

Building, of course, is active in the new and growing West; but what is equally important and pleasant in point is the fact that more and more attention is paid to architectural excellence and requirements. Superior architects are becoming numerous and are universally employed before constructions of any importance are commenced. The literature, too, of architecture is a very well established feature of the day. As the best periodical in the line, the Architect and Builder edition of the SCIENTIFIC AMERICAN may be mentioned. It is published monthly by Messrs. Munn & Co., the noted patent solicitors, No. 361 Broadway, New York. Price, $2.50 a year.

It is a beautifully illustrated serial of large size, magazine shape, and treats of the subject in all the respects of design, ornament, cost, and economy. The perusal of its pages affords a rich treat of abundant profit to any one the least concerned with or interested in building.

As an educator of the laity and a source of hints and suggestions to the professional it is without an equal. While small and medium sized structures receive profuse attention, larger ones are likewise elaborated in plain and detail.

In each number, also, a double page is devoted to handsome houses already built. The illustrations are printed in colors, showing how the finished erections appear appropriately painted.—*The Dubuque Trade Journal.*

Captain Robert B. Forbes.

Captain Robert B. Forbes, one of the last of the old merchant princes of Boston, died at his residence in Milton, Mass., November 23. No man has been more closely allied and identified with the shipping interests of the whole country than he. He took great interest in everything relating to the sea, and introduced many improvements in the construction and equipment of vessels of all classes.

Captain Forbes was born at Jamaica Plains, Mass., on September 18, 1804, and on January 17, 1811, his mother, his brother Thomas F., and himself embarked at Boston on board of the schooner Midas, bound for Marseilles, to join his father. Off the port the schooner was captured by a British frigate, which sent her to Fort Mahon. After considerable delay Mrs. Forbes and her boys reached France. Here the boys were sent to school. The master was as ignorant of English as they were of French, yet by close attention and the use of a French and English dictionary the boys soon acquired a sufficient knowledge of French to pursue their studies. On the 13th of May, 1813, Mr. and Mrs. Forbes and their boys embarked at Bordeaux on board the American schooner Orders in Council, bound for Boston. Shortly after leaving this port the schooner was attacked by a British cutter, which she beat off after an hour's fight, but was captured soon after by the frigate Pomone and taken to Lisbon. The Forbes family embarked in another vessel, and were again captured, but finally reached Newport, R. I., in the ship Ledd.

At the age of thirteen years, Robert B. Forbes went to sea before the mast in the ship Canton, packet, bound for China. When sixteen years old he was third mate; at twenty he was captain; at twenty-six he owned a ship and commanded her; at twenty-eight he left the sea; and at thirty-six he was at the head of the largest American house in China, and a man of fortune. His father was dead and his brother Thomas was drowned at Canton. He provided liberally for his mother and his younger brother, J. M. Forbes. During his seafaring career he traded between China, the United States, Europe, California, and South America, and was eminently successful in all his voyages. In 1847 Captain Forbes commanded the United States sloop-of-war Jamestown, laden with provisions for the starving poor in Ireland, and made the voyage from Boston to Cork and back in forty-nine days, and then helped to load the frigate Macedonian on the same errand of mercy. During the war of the rebellion he was employed by the government to inspect the building of several gunboats, and had built for himself the frigate Metea, 1,500 tons, to cruise in search of the vessels which were preying upon American ships. In all he built about seventy sail. He took a great interest in everything connected with seamen, so much so that he was called the "Howard of the Sea." He did much and wrote much about the best means of saving life in cases of disaster. In 1882 he published his "Personal Reminiscences," a model of condensed writing. At the age of thirty years he was married to Miss Rosa Green Smith, who died on the eighty-first anniversary of his birth. He had by her two sons, Robert Band and John Murray Forbes, and two daughters. Captain Forbes was a liberal supporter of every benevolent institution for seamen and soldiers. He was almost worshiped by the boys of Milton, for he made for them with his own hands over one hundred models of sail and row boats.

Captain Forbes was for many years a contributor to the SCIENTIFIC AMERICAN. His writings are marked by clearness of expression and the practicability of his views. Probably his very last contribution to the press was the article which we give this week on another page. It was written for the SCIENTIFIC AMERICAN at Milton on October 26 last, and contains excellent suggestions relating to the need for fresh water basins at our navy yards.

American Lighthouses.

The Lighthouse Board has submitted its report for the fiscal year ending June 30, 1889, to the Secretary of the Treasury. At the close of the year there were under control of the board 1,021 lighthouses and lighted beacons, 1,328 lights on Western rivers, and 4,284 buoys of various kinds. In the maintenance of these there are employed 1,934 light keepers and a number of miscellaneous employes.

The estimates for the ensuing year are $2,576,700. The estimates for special appropriations aggregate $3,290,650. The deficiency estimate is $211,496.

The board reports that the effort to light Gedney Channel, New York Bay, by electric lights, has been successful thus far.

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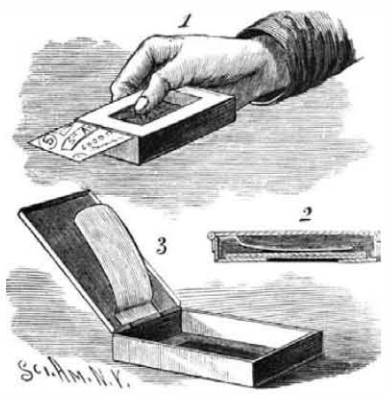
A POCKET TICKET CASE.

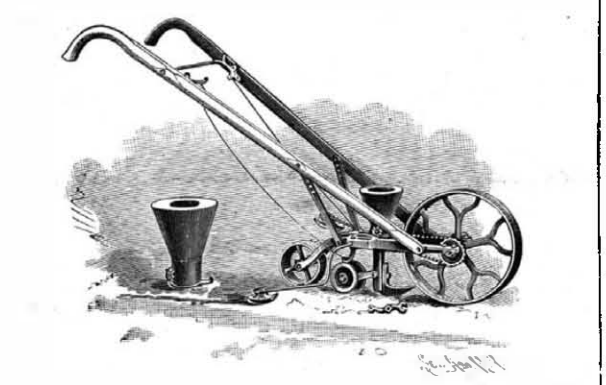
The accompanying illustration represents a simple and convenient pocket case or receptacle for carrying street car, ferry, stage, and other tickets. It has been patented by Mr. Frank I. Hart, of No. 151 East One Hundred and Twenty-third St., New York City. Fig. 1 shows the device in use, Fig 2 being a sectional view, and Fig. 3 showing the case open for the reception of tickets. The body section of the case is in the form of a box with a central opening in its top, and a transverse slot at one end, of sufficient width for a ticket to be passed through, while the cover section is a flanged plate hinged to one end or side of the bottom, its flanges engaging with the inner or outer faces of the body section, or the cover may be held closed by any approved form of clasp. A spring is secured to the inner face of the cover, as shown in Figs. 2 and 3, whereby the tickets are pressed upward to the top of the case, in position to be passed singly out through the slot by a slight pressnre of the thumb or finger upon the uppermost ticket through the opening in the top of the case.



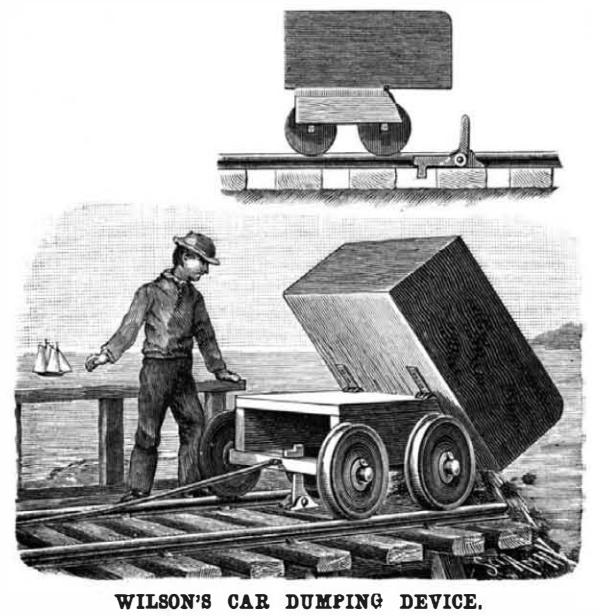
HART'S TICKET CASE.

AN IMPROVED SEED DRILL AND FERTILIZER DISTRIBUTER.

The accompanying illustration represents a simple form of drill specially adapted for sowing all kinds of garden seeds in rows and for distributing fertilizer. It has been patented by Mr. William H. Genung, of Madison, Ohio. The main frame has a top plate, in the middle of which, to the rear, is held a seed hopper having on its bottom a flange resting on the top plate, the flange having a downwardly extending lug passing through an aperture in the top plate. The rear part of the flange has a straight side, against which works an eccentric cam pivoted to the top plate, whereby the hopper is locked in position on the top plate. For distributing fertilizer a larger hopper is employed, either being readily locked in place by means of the eccentric cam. In the bottom of the hopper is an aperture, registering with one in the top plate, whereby the seed passes to the discharge spout, in front of the lower end of which is held a vertically adjustable plow or runner adapted to form a V-shaped furrow for the seed or fertilizer. On the spout is also pivoted a rearwardly extending forked arm, on which are held covering disks adapted to close the furrow after the seed or fertilizer has been dropped. The amount of seed or fertilizer delivered is regulated by a disk pivoted to the top plate and extending under part of the bottom of the hopper, the disk having nine different openings of varying sizes, any one of which can be brought to register with the aperture in the bottom of the hopper and the top plate, to govern the amount of seed passing down the spout. Near the lower end of the hopper is a feed wheel, operated by a sprocket chain, from the front driving shaft, whereby the seed in the hopper is kept from clogging in its passage to the spout. Markers are attached to the rods which extend from each side of the frame, to mark the position of the next following row on each side of the machine, and either one or both of the markers can be held out of contact with the ground by means of cords passing through eyes on the under side of the handles. A considerable number of these machines is already in use, and they are said to prove highly satisfactory.



GENUNG'S "IRON KING" SEED DRILL AND FERTILIZER DISTRIBUTER.



WILSON'S CAR DUMPING DEVICE.

Utilizing Niagara Falls.

The town of Niagara Falls, Ont., has in course of construction a new system of water works. The work is interesting from the fact that a greater part of it is being done near the brink of the Horseshoe falls. A tunnel 125 feet long, 6 by 7 feet in size, the mouth of which is 35 feet below the brink of the precipice, and which has now reached a depth through solid limestone rock of about 50 feet, is being made to serve as a tail race from the wheel house to the pump house. These buildings will stand just beyond the Table Rock House. The necessary water to operate the works will come to the wheel house through a wooden tube 6 by 8 feet in size, and about 600 feet long. A shaft is being sunk through the rock to allow of the discharge of the volume of water coming through the tube on to the water wheel and into the tail race or tunnel. At the upper end of the wooden tube will be an open cut 12 feet wide and 11 feet deep, extending about 150 feet outward toward the northern end of Cedar Island, where the water is deep. Outside or inside the wooden tube will be placed a 14 inch pipe, the end of which will extend some few feet beyond the mouth of the open cut near Cedar Island, and through this pipe will come the water that will be furnished throughout the town for general use. Work on the tunnel is carried on night and day. The works are expected to be in operation by June next.

Removal of Moles.

In a recent number of the *Practitioner* Dr. Jamison writes on the use of sodium ethylate in removing hairy moles on the face. He operated in this way. The hairs were cut off as closely as possible with a very fine pair of scissors, and the mole was then painted over with sodium ethylate, a fine glass rod being used. When the mole had a varnished look the ethylate was gently rubbed in with the glass rod, to make it penetrate more deeply into the hair follicles. The mole had quite a black look when the operation was over. A hard crust formed over it, which was nearly three weeks in becoming detached. When it came off the hairs were seen to be destroyed, and the surface of the mole had a smooth, somewhat cicatricial appearance, of a much lighter color than before; and this favorable condition continued until the mark was scarcely noticeable.

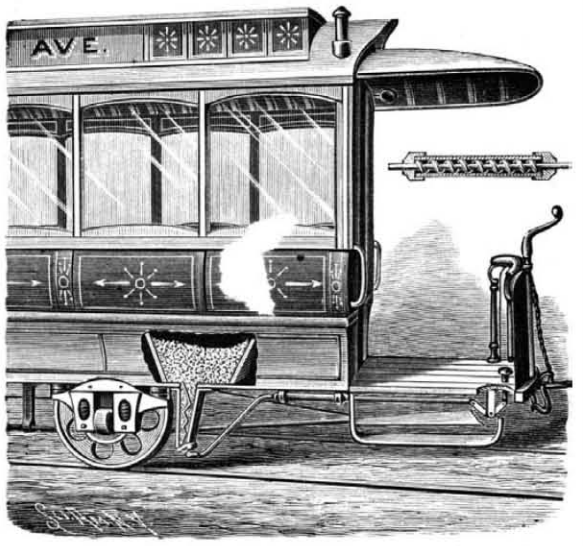
AN IMPROVED CAR DUMPING DEVICE.

A device to facilitate the dumping of four-wheeled cars, used to transport ore, coal, sand, earth, etc., whereby the cars may be automatically discharged of their contents at the edge of an embankment or the end of the track, is illustrated herewith, and has been patented by Mr. Charles F. Wilson. The body of the car is hinged to the terminal sloped ends of the car frame, the point of connection being such that, when loaded, the car body will be retained upon the frame by gravity, but the center of gravity is sufficiently near the hinge to readily permit of the tripping of the body over the sloped ends of the frame, by the sudden arrest of a forward motion in that direction. Near the edge of the embaukment or other point where the load is to be discharged, a bracket stand is secured upon one of the cross ties, midway between the rails, and a bell crank lever is pivoted to rock upon a shaft supported by the bracket, its limbs being at right angles to each other, as shown in the small view. The limbs of the lever are of such length that they will project above the axles of the car, the outer limb being straight and the inner one having a right-angled projection. As the car moves toward the point of discharge, its front axle abuts against the vertical limb of the bell crank lever, when in the position shown in the small view, the further movement of the car rocking the lever to elevate its prostrate limb between the front and rear axles, and cause the right-angled projection of the latter limb to hook above the rear axle of the car, thus suddenly arresting the car and dumping the load. The backward movement of the car restores the tripping lever to its original position, ready to engage the next loaded car.

For further information relative to this invention address Mr. R. C. Macy, Breckenridge, Col.

IMPROVED DEVICE FOR SANDING RAILROAD TRACKS.

An attachment especially adapted for street cars, enabling the driver to conveniently sand the rail in front of the wheel whenever desired, and prevent clogging of the sand in the discharge spout of the sand box, is illustrated herewith, and has been patented by Mr. John W. Bates, of No. 31 Willoughby Street, Brooklyn, N. Y. The sand box is located under the seat of the car, and on the lower end of the spout leading therefrom a valve is hinged in an inclined position. The valve is pivotally connected with one end of a rod which passes upward and horizontally through a barrel, in which a coiled spring is secured to the rod, as shown in the small figure. The rod extends outwardly under the car platform, where it is pivotally connected with one arm of a bell crank lever, the other arm of which is connected with a short rod passing upward through the bottom of the platform, and having on its upper end a knob adapted to be pressed upon by the foot of the driver. When the driver presses on this knob, the valve rod is operated through the bell crank lever, and against the tension of the spring in the barrel through which the rod passes, to open the valve at the bottom of the spout, the spring operating to close the valve when the pressure on the knob is removed. In order to prevent clogging of the sand in the spout, an upwardly extending crooked agitating rod is connected with the inner face of the valve, to agitate the sand as the valve is opened and closed.

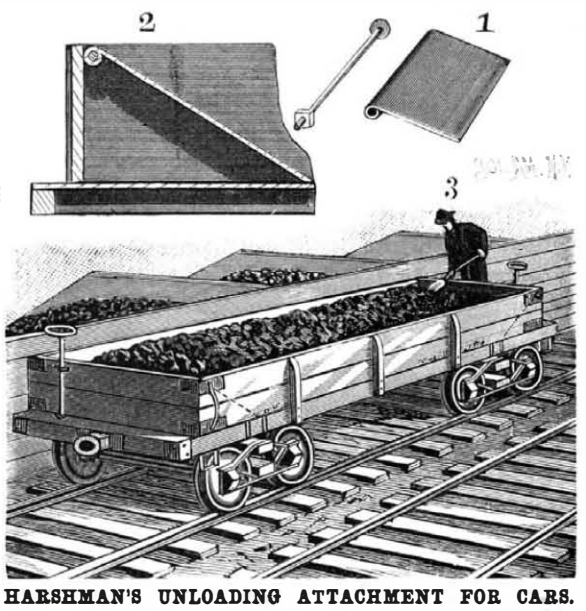


BATES' SANDING ATTACHMENT FOR CARS.

AN UNLOADING ATTACHMENT FOR CARS.

The accompanying illustration represents a recently patented device to facilitate the unloading of coal and other cars, when the material to be unloaded is of such a nature that a shovel cannot be readily inserted until a portion of it has been removed by the hands of the laborer, to expose the floor of the car body. It consists of a shoveling plate, or guide rest, made of sheet metal, bent upon itself along its upper edge to form a hollow half hinge, as shown in Fig. 1, a hinge rod passing through the half hinge having its bearings in the sides of the car body, as shown in the sectional view, Fig. 2. The same kind of a shoveling board can be used on covered box cars for unloading ear corn, potatoes, coke, etc., the bottom of the car being filled at the ends first, by turning up the shoveling board, afterward turning it down to rest upon the car floor, when the remainder of the load is added. In applying such a shoveling board to a grain door, the board should be made to run from one end of the door to the other, the board being turned up out of the way when the door is to be pushed to one side.

For further information relative to this invention address the inventor Mr. J. S. Harshman, Harshman, O.



HARSHMAN'S UNLOADING ATTACHMENT FOR CARS.

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THE BEAVER (CASTOR FIBER).

Among the rodents there is not another creature about which there have been so many fabulous stories as there have been about the beaver. The accounts of his skill in building, specially, are exaggerated, and recent researches have furnished the first satisfactory accounts of his habits.

In regard to the present distribution of the beaver in Europe, the greatest numbers of them are found in Poland, Russia, Sweden, and Norway, although isolated specimens are encountered on the Danube, Moselle, Weser, and other rivers of Central Europe. Formerly they must have been very numerous in Germany and the neighboring countries, for the names of many rivers and places indicate their presence. Thus, for example, the "Bohrfluss" in Silesia has, doubtless, derived its name from the Flemish word "bohr" (beaver), and the name of the imperial castle "Babelsberg" can be traced to the same source, "babel" meaning the same as "biber" (beaver.) The greatest numbers of these rodents are now found, however, in Alaska, which exports 30,000 skins annually. The darkest skins are considered the most valuable, the prices of such ones ranging from $12 to $14.

pressed, snout blunt, neck short, back arched, and his eyes are rather small. His small ears project very little from the fur, and can be laid down flat, so as to nearly close the ear openings. The incisors are extraordinarily strong, and project; and besides these, each jaw is provided with four molars. His legs are short and muscular. Each foot has five toes, and the hind feet are webbed. Both the male and female are provided with castoreum-secreting glands. In trade there is a distinction made between the Siberian and American castoreum, the former being considered the most valuable.

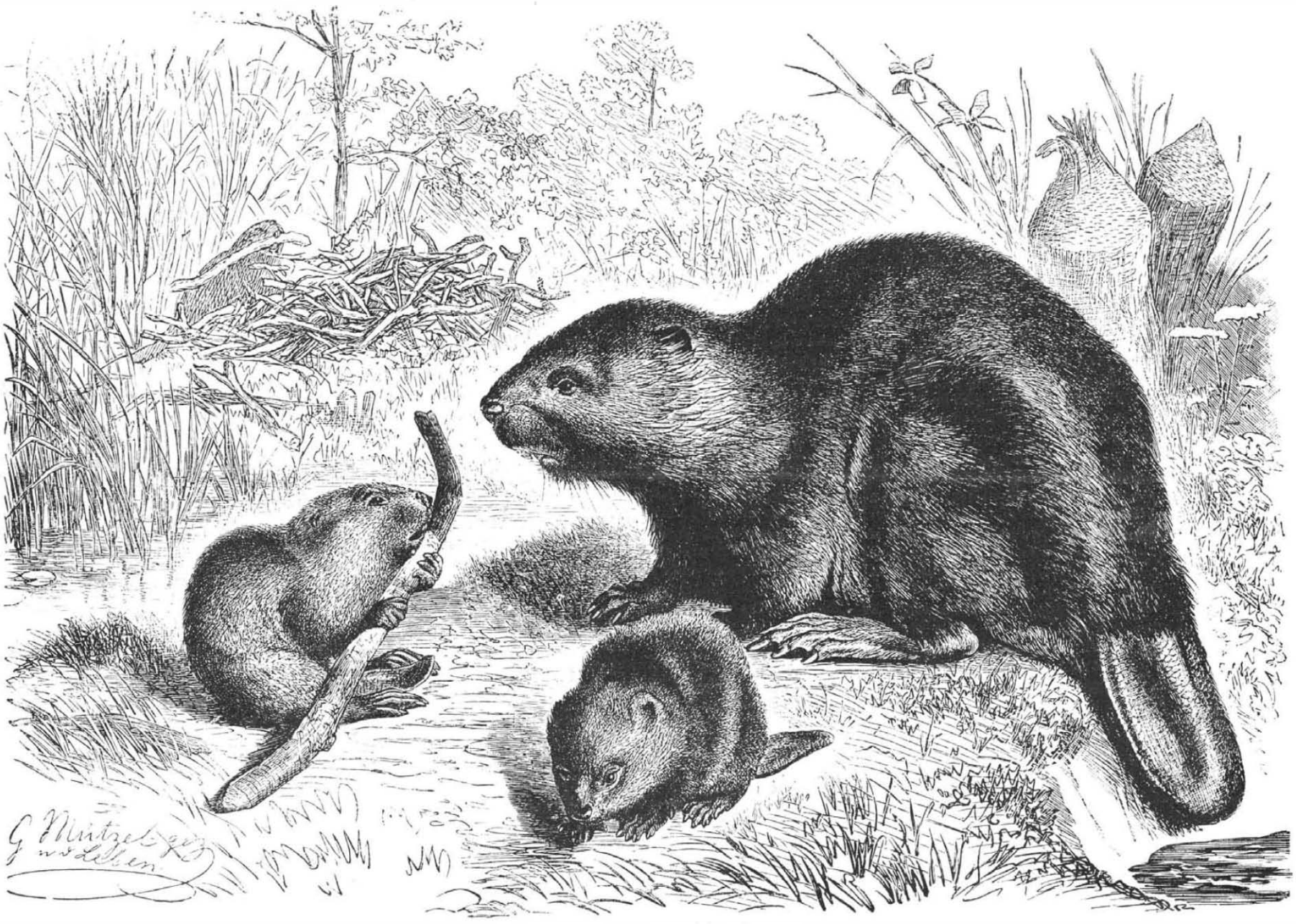
A half ounce of this salve-like mass costs from $20 to $24. It is used in medicine as an anti-spasmodic.

Each litter consists of from two to four young ones, which are weaned when about four weeks old. In less than two months they have gained sufficient strength to be able to follow the mother about. At the end of a year the young beavers are fully grown.—*Illustrirte Zeitung.*

Sulphur Recovery.

The chemical section of the British Association paid a visit during the late meeting to the Jarrow Chemical Company's Friar's Goose Works, where the new sulphur recovery process of Mr. Chance is now at work, and to the Newcastle Chemical Works Company, where plant to the value of £60,000 is now being erected for the same purpose. At the Friar's Goose Works the plant is capable of treating about one-third of the total waste produced at the company's works, and roll brimstone and "flowers of sulphur" are now among their salable products. It will be recollected that the new process is based on the fact that carbonic acid gas decomposes the calcium sulphide of the waste in presence of water, first into carbonate of lime and calcium sulphydrate, and finally reacts with the latter, forming a second quantity of carbonate of lime and sulphureted hydrogen gas. The plant is so arranged that the process is a continuous one, the carbonic acid being led under a pressure of 40 pounds into large tanks containing the alkali waste arranged in series at such a rate that at the end of the series pure sulphureted hydrogen gas is evolved and collected in gas holders. The operator is able to introduce the carbonic acid into any of the tanks by turning valves, and the gas which issues from the different tanks is tested from time to time by burning in a Bunsen burner, so that only a gas rich in sulphureted hydrogen is allowed to enter the gas holders. At the Friar's Goose Works, only part of the sulphureted hydrogen produced in this way is converted into sulphur in the Claus kilns. The remainder is introduced directly into the pyrites kilns, where it burns, and the sulphurous acid produced passes with that derived from the pyrites directly into the vitriol chambers. It is calculated that about 75 per cent of the total sulphur present in the alkali waste is thus recovered.

The Newcastle Chemical Works Company, through the enterprise of Messrs. Allhusen, will shortly have the largest plant at present made for the process, and will be able to convert the whole of their waste into marketable sulphur. The sulphuric acid used on these works is all derived from pyrites smalls, containing about 50 per cent of sulphur, and about 30,000 tons of pyrites are burnt annually to produce sufficient acid to decompose the 50,000 tons of salt which the company require per annum. This quantity of acid will therefore give 15,000 tons of total sulphur at present lost in the waste, and which the new plant is meant to recover, or, assuming that two-thirds only is recoverable, will mean a yield of 10,000 tons of sulphur per annum. The kilns for generating the carbonic acid required to effect the decomposition of the waste are of special construction, being built on the Dietz system, and fired with cinders and refuse coal from the other parts of the works. These works at present can produce annually about 18,000 tons of bleaching powder and 20,000 tons of 60 per cent caustic soda. The salt used is obtained from the company's salt works at Cowpen Marsh, South Durham, where extensive beds of rock salt exist at a depth of 1,000 to 1,200 feet. In addition to the new plant, the visitors had an opportunity of visiting the old works, and were shown the manufacture of 77 per cent caustic soda, which is replacing the cruder forms of the article in paper making and in other industries, which can be more economically worked with a strong and pure lye derived from a high strength caustic.



THE BEAVER (CASTOR FIBER).

Our cut shows a female with her young at home. On the farther bank we see the male, peeling and piling up pieces of wood, which furnishes the principal material for their so-called "lodges." These lodges are made of branches and sticks thrown together in confusion and cemented together by quantities of sand and mud. The beavers fell their building material by means of their very strong teeth; they bite right through inch thick sticks, while the stems of larger growth they cut down by gnawing around them. When felled, the trees are first robbed of their branches, then cut up, and the pieces used in building. The bark, which is their favorite food, is eaten at once, or stored away.

When completed, a lodge looks like an arched oven, and contains room for storing their winter food, besides the space in which they sleep. The beavers work incessantly on their dwellings, enlarging and improving them, carrying in provisions, etc., until the frost puts a stop to this industry. They erect these skillful structures only when living in large companies. Individuals living by themselves dig tunnels, which begin below the water level and end at a distance from the bank.

The beaver is one of the largest rodents. A full-grown male measures from 2½ to 3 feet in length, and weighs from 40 to 50 pounds. His tail has a scale-like covering, his body is rather plump, his head broad and com-

Niter Deposits.

Caves containing deposits of earth with from 4 to 30 per cent of calcium nitrate and 5 to 60 per cent of calcium phosphate are common in Venezuela, not only in the littoral mountain chains, but also on the flanks of the Cordillera of the Andes. In these deposits are embedded remains of mammalian bones, preserving their form, but so friable as to fall to powder when they are extracted. They consist solely of calcium phosphate; the gelatin has been nitrified and dissolved out, and the calcium carbonate of the bone bas been used up in neutralizing the nitric acid produced. The nitric ferment is found in abundance throughout the deposits in a very well developed form. Some of these deposits are 10 meters thick.—*Jour. Soc. Chem. Ind.*

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THE NEW CHICAGO WATER WORKS.

(*Continued from first page.*)

lon. The lake water, however, is remarkable for its good quality. It contains only 8 grains of total solids to the gallon, approximating in purity to distilled water.

Although this original water works had an excellent record, supplying water continuously for many years, under pressure limited by a stand pipe 130 feet high, being interrupted only for a few days during the great fire of 1871, the increase in population of the city has excited apprehensions as to its sufficiency, and new water works, on a greatly increased scale, are now in process of construction. We illustrate these operations, and the views show our readers what is really one of the great engineering works of the day.

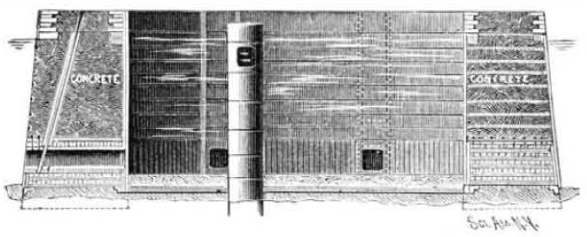
The general design of the new works provides for a tunnel which is to extend under the lake for four miles easterly from Park Row. This is to be about double the length of the old tunnel. Under the city proper two miles of tunnel are constructed, so as to connect two new pumping works, one for the south and the other for the west division of the city. The old system of tunnels and pumping works for the north division of the city will be brought into connection, by means of the tunnel under the city, with the new system, so that old and new tunnels and water works will all be connected and be susceptible of working together. The original intention was to have built a tunnel of 96 inches internal diameter. Upon investigation, it was found that the ground under the lake was not adapted for so large a structure. A stratum of bowlder clay, suitable for tunneling, was found beneath the lake, but was both overlaid and underlaid by strata of dangerous or unreliable character. The clay layer was too shallow to receive an 8 foot tunnel, so it was decided to construct two 72 inch tunnels parallel with each other, and situated about 50 feet apart.

The work within the city limits was constructed from three shafts, located at proper intervals, and these two miles are now complete. As regards the lake tunnel, about three-quarters of a mile are now finished, leaving a little over three miles still to be built.

The work under the lake is being constructed from four shafts, the first one being situated on the shore at the foot of Park Row. The depth at which the tunnels are built varies from 75 feet to 110 feet below the city datum. The lake shafts are three in number. The first is located one-half mile from shore. A pumping station was necessary at this point during the construction, in order to keep the works drained, owing to the grade. From the standpoint of the city's uses it is foreseen that this might be used for temporary supply if the completion of the terminal crib and connections was from any cause delayed. It is also possible that this shaft may ultimately be connected with the South Side water works by an independent tunnel, in order to be used as an intake for a high pressure water service to run elevators and machinery. The other lake shafts are two and a half miles and four miles from shore. The two and a half mile shaft is a structural one only. All the permanent shafts are heavy cast iron cylinders, built in sections, protected by hollow cribs or caissons.

The caissons for the first two shafts in the lake are built of 12 × 12 timbers, bolted together by 1¼ inch drift bolts. Taking as an example the two and a half mile caisson illustrated in one of our views, it represents two concentric pentagons, with their parallel walls twenty feet apart, providing an inner clear space of about 26 feet in diameter, the outer diameter being 72 feet 6 inches. The almost annular space between the two pentagons is filled with heavy rock, which rests upon the floor or bottom of the structure, which is made quite water tight. This floor extends over the area between the two pentagons, leaving the center well free. The pentagonal shape of the caisson affords a good place for vessels to lie at, each side being 47 feet 6 inches in length. The shaft descends through the center of this structure. The half mile shaft is of similar construction, and is the one which it is proposed to adopt as part of the water supply; it is further protected by a breakwater run out from shore. But the work of greatest magnitude is the four mile permanent caisson. It represents, in general terms, an annulus or ring of combined steel, timber, granite, and concrete, 125 feet in external diameter at the base, 118 at city datum when in position, 70 feet in internal diameter, and 53 feet in height. The bottom course is of timber. A grillage of solid white pine timbers, 12 by 12 inches each, was built up in the shape of a ring, 13 feet in depth, 125 feet in external diameter at the base, 123 feet at the top, and 70 feet in internal diameter.

Drift bolts, 1¼ inches in diameter, 2 feet long, and spaced not over 6 feet apart, are used to secure the members of this enormous mass of timber; inside and out it is planked with double vertical courses of 6 inch plank, the outer course being of white oak. Shoe courses of timber, 24 inches deep, run around its bottom, outside and inside, and two 12 inch courses of timber were specified to floor the bottom of th well. Upon the top of this ring-shaped structure are based two cylinders of steel plate ⅜ of an inch thick. The inner cylinder, 70 feet in diameter, rises vertically from around the inner wall of the grillage. The outer cylinder rises from the outside of the grillage with a slight batter inward; 24 radial bulkheads connect the two steel cylinders. The cylinders and bulkheads are bolted down to the timbers, some courses of bolts running through the entire 13 feet of timber and 2 feet of shoe courses. Through the timber six ports, 5 feet square, provided with gates and fish screens, are carried for the admission of water. The immense mass, owing to the timber and the air space, as it was built absolutely water tight, possessed considerable buoyancy, and floated on the water after launching and completion. The best quality of concrete, with large stones embedded in it, was then filled into the hollow annulus between the iron plates until it was sunk well down into the water, in order to do as much of the work as



CHICAGO WATER WORKS—CAISSON SECTION.

possible near the shore. It was then towed out to its place and more concrete added until it sank and rested upon the bottom of the lake, at this point 42 feet deep. The concrete was then filled up to the level of the top of the steel work. About 24,000 tons of concrete were used for this operation. This brought the upper line of steel within a few feet of the water or city datum plane. Two walls of granite, circular and concentric, were then carried up 8 feet above the iron plates, and the space between them is filled in solid. Upon this foundation a lighthouse is to be established to warn vessels of the proximity of the caisson.

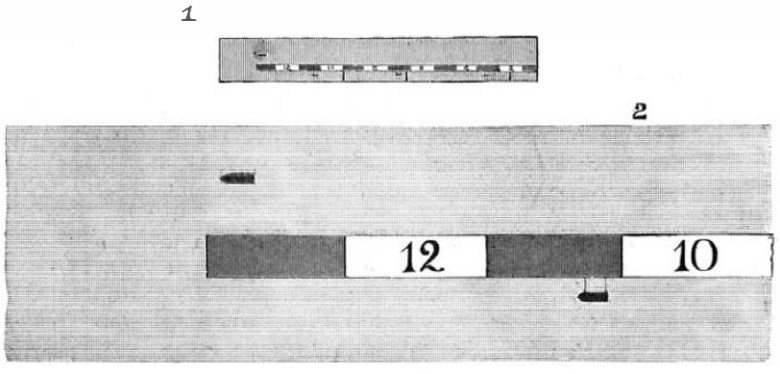
Within the caisson is the 70 foot well formed by it, floored with 8 feet of concrete. Here the main inlet shaft is situated, leading to the tunnel. It is a cast iron pipe 10 feet in diameter and 2¼ inches thick, made in sections joined by bolts passing through internal flanges with calked lead joints. Near its top two gates, 5×6 feet, are provided for the admission of water. The object of making so massive a structure is to secure it against disturbance from storms and to avoid the necessity of building around it a breakwater, which, as already stated, was found necessary in the case of the intake of the original water works.

These works were put under contract by the city of Chicago with Mr. Andrew Onderdonk, New York, about two years ago. Since that period the work has progressed night and day uninterruptedly, and in two years more it is believed the work will be completed. The end caisson was built under the direct charge of General Charles Fitzsimmons, of Chicago. In many respects the work is unequaled by anything of the kind ever undertaken. The new pumping stations will, of course, be constructed of the most advanced type, and we illustrate in elevation one of the buildings which it is proposed to erect for such use.

Whether the International Fair of 1892 be held in New York or Chicago, it is fair to assume that the new works here described will be one of the important objects for the inspection of visitors to America.

A FEAT IN PHOTOGRAPHY.

Trotting horses, leaping acrobats, running hounds, even a locomotive at full speed, have proved comparatively easy subjects for instantaneous photography,



PHOTOGRAPH OF FLYING PROJECTILE.

but certain other moving objects have severely tested the skill of the photographer as well as the capacity of the apparatus employed.

Perhaps the most difficult feat yet attempted in the line of photography is that of catching an impression of a bullet or cannon ball as it flies across the field of the camera. This has been accomplished with varying degrees of success, but most of the specimens of this class of work hitherto produced have been at the best mere streaks, not in any way resembling the projectile. This failure to procure a sharp impression is shown by the photograph itself to be due to lack of shutter speed.

A recent invention, to which we alluded a short time since in an article on "The Tachyscope," has apparently obviated this difficulty, so that it can no longer be said to be impossible to secure a recognizable picture of a flying projectile.

Last year Mr. Ottamar Anschuetz, of Lissa, Prussia, tried some very interesting experiments at Gruson, near Magdeburg in Germany, which demonstrate the practicability of photographing a flying bullet by daylight. Mr. Anschuetz constructed a small camera of great strength, in which he arranged a shutter of his own invention, which in this case was operated by an eight hundred pound weight. The shutter is arranged immediately in front of the sensitive plate, and consists simply of a curtain having a narrow slit as long as the plate, the width of the slit being variable. This slitted curtain passes over the entire face of the sensitive plate, exposing successive portions thereof to the action of the light. This arrangement insures a brief exposure of all portions of the image of the moving figure, thereby producing an extremely sharp negative. The slit in the shutter during this experiment was adjusted to a width of 0·002 of an inch.

Fig. 1 of our engraving represents the photograph in its actual size. Fig. 2 shows the photograph enlarged. In the field of the camera, which covered a space of 46 feet, Mr. Anschuetz drew a canvas curtain, and at every 13⅛ feet suspended a projectile 12 inches long, for comparison with a projectile of the same kind to be fired from a cannon. At a distance of 200 feet a wire netting was placed, which was connected electrically with Anschuetz's drop shutter. The projectile passed through the wire netting at a velocity of 1,312 feet per second, and its image was caught on the sensitve plate after having sped along the canvas curtain a distance of 42 feet. The shutter passed over the plate in the short space of 75-1,000,000 of a second. The numbers marked on the canvas indicate the distance in meters. The projectile shown below the space between the 10th and 12th meters is one of those suspended for comparison; the other shown above the 13th meter is the one photographed in its flight.

The photograph we reproduce was furnished us by the United States Photograph Supply Company, of No. 3 East 14th Street, New York City, who represent Mr. Anschuetz in this country.

A New Antiseptic.

Under this title a paper was read before the Medical Society of London, on November 4, by Sir Joseph Lister. The antiseptic is the double cyanide of mercury and zinc, and is prepared as follows:

A soluble double cyanide of mercury and potassium is dissolved, and to it a soluble salt of zinc is added; the precipitate formed is the double cyanide, which should be well washed with water to free it from any soluble cyanides, as they cause irritation and suppuration if placed on a wound in the shape of gauze.

One in 2,000 of double cyanide keeps blood serum and corpuscles from putrefaction, but if the wound has developed bacteria a much stronger solution or powder or gauze must be used. In other words, the double cyanide has a strong inhibitory but a weak germicidal power. Gauze is prepared in the following way: The double cyanide is triturated with starch, and water is added to this, the result being a somewhat leather-like mass. The water is strained off, and to the mixture of double cyanide and starch sulphate of potassium is added. This enables the mixture to be easily powdered, and, when it is dry, it is a fine white powder. In order to fix this powder on gauze, 3 per cent or 5 per cent of it is suspended in a 1 in 4,000 solution of mercuric chloride, when, by the agency of the starch, it sticks so firmly that it cannot be washed off except with difficulty.

Sir Joseph Lister said that the dressings should be used moist, and he had a little contrivance which he employed to show the surgeons present how they might prepare the gauze themselves, as he had made it a point that the gauze should be made as required. The exact composition of the double cyanide is uncertain, and is being investigated in the Pharmaceutical Research Laboratory.

The Tallest Chimney Yet.

The Clark Thread Company's chimney, at East Newark, N. J., which was illustrated in these columns not long ago, and claimed to be the tallest chimney in this country, has been supplanted by a smokestack just finished at Fall River, Mass., which is 340 feet high above the granite base and 30 feet square at the bottom. The shaft was built on the grounds of the Fall River Iron Works, and is, without doubt, the tallest smokestack in America.

The tallest finished chimney in the world is at Paisley, Scotland, and is over 500 feet high. Fall River's new chimney will furnish draught for four new factories.

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Correspondence.

Fresh Water Basins for Navy Yards.

To the Editor of the Scientific American:

In your paper of this date, page 256, I find some interesting suggestions on the subject of the improvementof the New York navy yard, and especially in regard to a fresh water basin in which to put iron or steel ships when out of commission, and so prevent the rapid deterioration of the plates.

Several years ago I suggested that every navy yard should have what I termed "storage basins," large enough to contain one, or perhaps two, ironclads. My idea was and is to have the basins supplied with fresh water, when any water was needed, from the city water mains, but generally the basins were to be kept dry, so that the bottoms of the ships could be attended to. To haul up iron or steel ships in salt water has always seemed to me to be very much like committing suicide. I think that basins or stalls to contain not over two ships at a time would be better than to have one large basin for what your correspondent calls "our gallant navy." If my plan should find favor, comparatively little water would be required, and it could be procured from the public works. Salt water and high tide are good enough to carry the ship into her dock, block her up and let the water run out, close the gate and wash out with fresh water, dry the ship thoroughly inside and out, paint her and let her stand all ready for duty. Each of our yards would probably require three basins each to store two ships. All that is needed will be time and money. R. B. FORBES.

Milton, Mass., October 26, 1889.

Stopping Vibrations Caused by Falling Water.

That portion of our space which we are able to devote to auswering the inquiries of our friends who write us, asking questions upon almost every conceivable topic, is far from adequate, and we have to supplement it by sending many more answers by mail than we print in the paper. The following correspondence covers an instance of this kind, such as it is pleasant to record, where our answer exactly fitted a special case, although it was of a kind not likely to occur frequently:

——— ———, N. H., Oct. 19, 1889.

To the Editor of the Scientific American:

We have just let the water over a new dam, with a perpendicular face of 16 feet, falling on to an apron 4 feet under water; length, 140 feet. One end hugs close to a stone abutment, opposite end is open, so one could walk in. Water strikes between 5 and 6 feet from base of dam. Sheet of water wavers or flutters, sounding something like the exhaust of a high pressure steam engine running at medium speed. The vibration is felt for a mile around, more on the high ground, and sufficient to annoy the inhabitants. It movesloose windows and doors, also dishes. Please explain cause and remedy.

[*Reply.*—The vibration of the sheet of water flowing over the dam is due to the evenness of the thickness of the water. The elasticity of the air confined within the area propagates any vibration that may start in any part of the falling sheet to the whole mass, giving it, under certain conditions, a perfect wave, synchronal with the condition of the surrounding atmosphere. A ragged edge to the dam or a number of breaks in the sheet at unequal distances will break up the sound waves.—ED.]

———— ———, N. H., Oct. 29, 1889.

To the Editor of the Scientific American:

Your esteemed favor is at hand. Did not expect you to answer by letter. I am very glad you did. Before your kind answer came, a log came down stream, lodging on crest of dam, which stopped a good part of the troublesome vibration. We decided to put a foot bridge on crest of dam, with fourpiers, 12 inches wide, projecting a trifle over edge of dam, and are quite right now. Thanking you many times, I am,

Very respectfully,

The Mongolian Pheasant.

This valuable addition to our native game birds was imported from China a few years ago. It has increased with surprising rapidity in western Oregon, Washington, and in the northwestern corner of California, under effective legislative protection.

It is unusually prolific, hatching two and frequently three clutches perseason, the first nest containing eighteen to twenty-five, the last from twelve to sixteen eggs. This accounts for the fact that several different sizes of chicks are frequently seen in one covey. The first brood when hatched is turned over to the care of the male until the second and third broods appear, when all are combined and cared for by both parents.

They do well in confinement. Hatched by the domestic hen, they are as apparently contented in following her as on their native heath; but at the age of six weeks they "shake" their adopted mother and depart, never to return, much to her grief and disgust.

The plumage of the male is extremely brilliant and attractive. As a table dish it equals the partridge and prairie chicken of the East.

THE motion for an injunction in the case of the Bridgeport Wood Finishing Company *vs.* The New York Wood Finishing Company recently came on to be heard before Judge Wheeler in the Circuit Court of the United States for this district, and was argued by S. J. Gordon, Esq., for the complainant and Albert Comstock, Esq., for the respondent. The judge sustained the Wheeler patent, and ordered the injunction to issue.

Naval and Marine Requirements.

If official recommendation were of any avail, the country would long ago have been in possession of war vessels and commercial steamers equal to any in the world. But the dilatory action of Congress in the matter has up to this time kept the United States in the background. We have made a slight progress, however. We have built half a dozen new ships, but they are not of the latest forms, and they are lacking both in speed and defensive power. They can neither resist nor run. Let us hope the new Congress now in session will enact the necessary provisions for a great and effective naval system. The display of congressional enthusiasm and vigor in the premises would give much satisfaction to the people.

The President in his recent message presents the following:

"I recommend that such appropriations be made for ocean mail service, in American steamships, between our ports and those of Central and South America, China, Japan and the important islands in both of the great oceans, as will be liberally remunerative for the service rendered, and as will encourage the establishment and in some fair degree equalize the chances of American steamship lines in the competitions which they must meet. That the American States lying south of us will cordially co-operate in establishing and maintaining such lines of steamships to their principal ports I do not doubt.

"We should also make provision for a naval reserve to consist of such merchant ships, of American construction and of a specified tonnage and speed, as the owners will consent to place at the use of the government. in case of need, as armed cruisers. England has adopted this policy, and as a result can now, upon necessity, at once place upon her naval list some of the fastest steamships in the world. A proper supervision of the construction of such vessels would make their conversion into effective ships of war very easy.

"I am an advocate of economy in our national expenditures, but it is a misuse of terms to make this word describe a policy that withholds an expenditure for the purpose of extending our foreign commerce. The enlargement and improvement of our merchant marine, the development of a sufficient body of trained American seamen, the promotion of rapid and regular mail communication between the ports of other countries and our own, and the adaptation of large and swift American merchant steamships to naval uses, in time of war, are public purposes of the highest concern.

"The enlarged participation of our people in the carrying trade, the new and increased markets that will be opened for the products of our farms and factories, and the fuller and better employment of our mechanics which will result from a liberal promotion of our foreign commerce insure the widest possible diffusion of the benefit to all the States and to all our people. Everything is most propitious for the present inauguration of a liberal and progressive policy upon this subject, and we should enter upon it with promptness and decision.

"The legislation which I have suggested, it is sincerely believed, will promote the peace and honor of our country and the prosperity and security of the people. I invoke the diligent and serious attention of Congress to the consideration of these and such other measures as may be presented having the same great end in view."

The Secretary of the Navy, Mr. Tracy, is keenly alive to the naval requirements of the country. In his annual report he says:

"The necessities of our vulnerable position demand the immediate creation of two fleets of battle ships. They must be the best of their class in four leading characteristics—armament, armor, structural strength, and speed. Not only must the speed of our battle ships be high, but it must be uniformly high, for the speed of the fleet is regulated by that of the slowest vessel.

"In addition to the battle ships the situation of the country requires at least twenty vessels for coast and harbor defense. The one problem now before the government, in the matter of a naval policy, is to get these forty vessels built at the earliest possible moment. It is recommended that the construction of eight armored vessels be authorized at the coming session, and that they be of the type of battle ships rather than coast defense ships, the former being more generally serviceable and there being only three of them now in process of construction as against eight of the latter.

"In reference to fast cruisers, all modern experience goes to show that they are essential adjuncts of an armored fleet, and the proportion of three cruisers to one battle ship is believed to be sound and reasonable. This would make the future navy consist of twenty battle ships, twenty coast defense ships, and sixty cruisers, or 100 vessels in all, which is believed to be a moderate estimate of the proper strength of the fleet. Of the sixty cruisers required, thirty-one are now built or authorized. It must be remembered, however, that cruisers have another and equally important function in the attack and defense of commerce. Any stanch vessel with a good coal capacity and the highest rate of speed, armed with a few rapid-firing guns, though built and used principally for commercial purposes, may by certain adaptations in her construction be made readily available for this form of warfare. The fast transatlantic liners, nationalized in foreign countries, but supported and maintained by American trade and American passengers—many of them, even, owned by American citizens—are a powerful factor in the naval force of the governments whose flag they bear and at whose disposal they must place themselves in time of war.

"It is matter for serious consideration whether steps may not be taken toward the creation of such a fleet of specially adapted steamers of American nationality, owned by American merchants, carrying the American flag, and capable under well defined conditions of temporary incorporation in the American navy. The advantages of such an arrangement, which enlarges the merchant marine and makes it at the same time self-protecting, are overwhelmingly great. The difficulty is that American capital will not be drawn into the enterprise unless it can be sure of specific compensation for the concessions which it makes to the government—first, in the adaptation of its vessels to the latter's needs, and, secondly, in the surrender of a privilege to use them when the exigency arises. In the absence of such an arrangement, the naval policy of the United States cannot neglect to take account of the fleets of fast cruisers which foreign states maintain under the guise of passenger and merchant steamers.

"They constitute an auxiliary navy, and must be reckoned as a part of the naval force of the governments maintaining them. It is difficult to imagine a more effective commerce destroyer than the steamship City of Paris, armed with a battery of rapid-firing guns. She can steam over 21 knots an hour, and can average 19·9 knots from land to land across the Atlantic. No man-of-war could overtake her; no merchantman could escape her. A fleet of such cruisers would sweep an enemy's commerce from the ocean.

"Our deficiency should be supplied either by a line of fast merchantmen, constructed with special reference to use in time of war, which will enable the government to avail itself of their services at critical moments, or we should build a fleet of at least five first-class cruisers of the very highest rate of speed, certainly not less than twenty-two knots. The displacement of these vessels should not be less than 4,000 tons. Even such a fleet will not supply the want of swift merchant steamers for coaling and transport service. Colliers and transports must alike be fast, for they cannot fight, and the collier can take no chance of capture, for she carries the life of the fleet. Apart from the want of battle ships, the most marked defect of the present fleet is in torpedo boats. This branch of defense cannot safely be neglected any longer. It is high time that steps should be taken to supply these essential constituents of a naval force. I therefore recommend that the construction of at least five torpedo boats of the first and second classes, in suitable porportions, be authorized as a beginning at the coming session of Congress."

While Congress is deliberating over the above excellent recommendations, let us hope it will also consider the significance from a naval point of view of what a railway company just north of us is doing, and which is briefly described as follows:

"The new vessels now building for the Canadian Pacific Railroad, and destined to run on the. Pacific side of the great route about to be established between England and India, are to be fitted with gun platforms. Rapid-fire guns are to be assigned these vessels, and it is understood that the pieces will be carried on board either mounted or stored below decks for immediate use in time of war. The vessels, on the breaking out of hostilities, will be at once turned into armed cruisers. The engineer in charge of the construction, Mr. Bryce Douglass, is the man under whose supervision the Umbria and Etruria were built. The total dead weight of each of the new steamers will be about 3,750 tons. They will all be ready, it is thought, early in 1891."

New Gas Invention.

The Pittsburg *Dispatch* describes a new invention by Mr. William Root, which promises important results.

It consists of the combination of air with the gas as it issues from the burner. The experiment made was with a small revolving fan on the same shaft that runs the other machinery. A pipe from this connected from beneath with a glory hole and ran up to the center of the burner. Heretofore it has required the valve wheel on the gas supply pipe to be turned once and a half around to supply enough pressure for the glory hole, but when the air was turned on, the wheel only required to be moved ¼ inch. The usual pressure to a glory hole is 1 ounce, while in this case the pressure was a very small fraction of this amount.

Mr. Root said that by putting the air in all the burners the pressure in the factory could be reduced to 3 ounces where 16 to 20 are now required.

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HOW TO MAKE A SIMPLE ELECTRIC TELEPHONE REQUIRING NO BATTERY.

The engravings represent an electric telephone in the simplest form. This instrument may be made by the use of a jackknife and a few of the simplest tools, and the materials of which it is composed, with the exception of the fine wire on the spool, may be found almost anywhere.

To make an operative telephone line, one that will work for any distance, say up to five or ten miles, two of these instruments are required, to be connected by the line wires. No battery is necessary.

The engravings being of the exact size, it will be unnecessary to give dimensions, as they may be obtained from the cuts.

For the telephone shown in perspective in Fig. 1 and in section in Fig. 2, the following materials are required, viz., a small horseshoe magnet of the size shown, a wooden pill box, a block of wood, a piece of thin tin plate, one ounce of No. 36 silk-covered copper wire, and a few common screws.

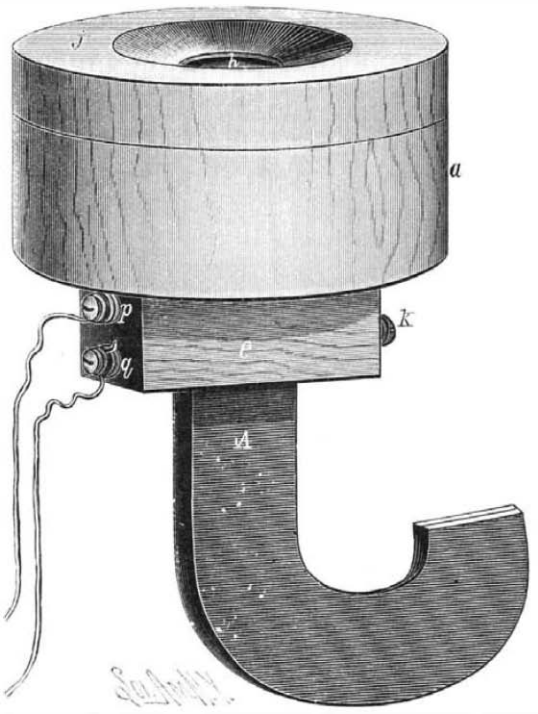

Fig. 1.—SIMPLE TELEPHONE—PERSPECTIVE VIEW.

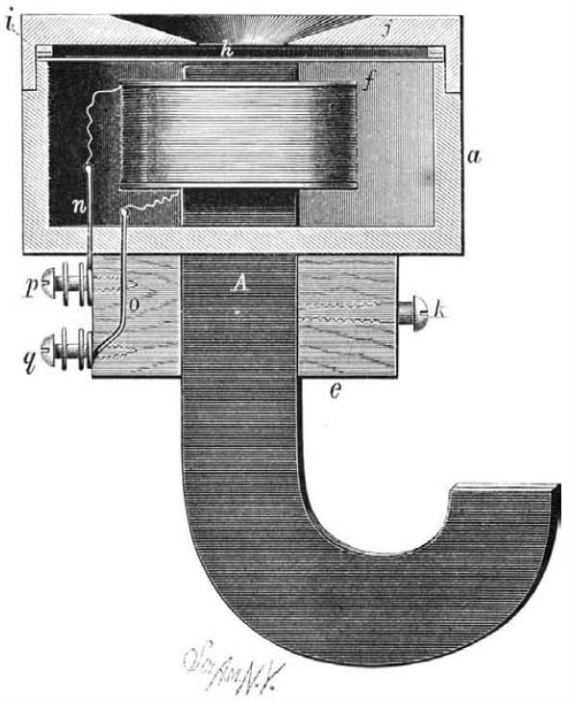

Fig. 2.—SIMPLE TELEPHONE—SECTIONAL VIEW.

One leg of the magnet is broken off, as shown. To the other leg, A, is fitted the mortised block, *e*. To this block is glued the wooden pill box, *a*, which is apertured to receive the pole of the magnet. The box may be of the size shown, or a little larger or smaller. A little variation as to the size will make no appreciable difference in the working of the instrument. In the center of the cover, *j*, of the box, *a*, is made a circular hole, which is flared as shown, to form the mouth piece. To the cover is loosely fitted the thin tin plate which forms the diaphragm, *h*. Between the diaphragm, *h*, and cover, *j*, are placed cardboard rings, *i*, to hold the diaphragm in place.

To the end of the magnet is fitted a thin spool, *f*, made of cardboard or wood, and upon this spool is wound the No. 36 silk-covered copper wire. The inner end of the wire is carried through a hole in the side of the spool before winding.

In the block, *e*, are inserted two common screws, *p*, *g*, each provided with two copper washers or burrs. Around these screws are wrapped the ends of the wires, *n*, *o*, which extend into the pill box and are soldered to the ends of the fine wire on the spool. In the block, *e*, is inserted a screw, *k*, which bears against the edge of the magnet and clamps the magnet in working position, that is to say, with the end of the magnet placed as near the diaphragm, *h*, as it can be without producing a jarring sound when the diaphragm is made to vibrate by talking to it loudly.

To make the diaphragm cell, A, take a square block of hard wood and cut in it a circular hole, B, of the size shown on the engraving, and fasten to the apertured block a bottom piece, C, by means of glue or small common screws. In the center of the bottom of the diaphragm cell, A, make an aperture in which to insert the pole, D. This is formed of the head end of a large common iron screw, the beveled part of which projects beyond the diaphragm cell a short distance to insure a good contact with one of the poles of the magnet, E, and the outer end of the pole piece is a short distance below the level of the face of the diaphragm cell.

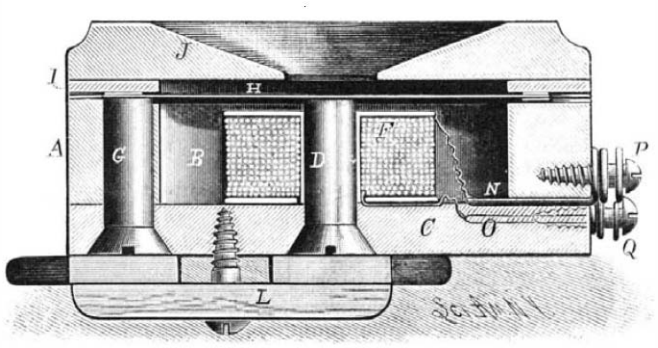

Fig. 5.—TRANSVERSE SECTION OF BIPOLAR TELEPHONE.

To this pole piece, D, is fitted a pasteboard spool, F, of the size shown, and upon this spool is wound as much of the No. 36 silk-covered wire as it will hold. Before the winding is begun, the end of the silk-covered wire must be passed through a hole in the side of the spool, where the flanges join the cylindrical part. This wire should project from the spool two or three inches, and while the spool is being wound, great care should be taken not to break this projecting end of the wire, as an accident of this kind would necessitate rewinding the spool.

The spool may be filled upon a lathe or the bobbin winder of a sewing machine, or, when no better facilities are available, it may be wound by hand. It is preferable to make the winding as smooth as possible; but this is not essential.

In the diaphragm cell. A near one of its edges, is inserted a second pole piece, G, formed like the pole piece, D, of the head end of a large common iron screw. The beveled head of the screw projects from the face of the diaphragm cell sufficiently to form a good contact with the remaining pole of the magnet, E. It also projects upwardly a short distance beyond the upper face of the diaphragm cell, so that when the diaphragm, H, is placed over the circular aperture of the diaphragm cell, it will form a magnetic contact with the end of the pole piece, G.

The diaphragm, H, consists of a disk cut from a ferrotype plate or from a thin tin plate, and where it touches the pole piece, G, the tin or japan with which the plate is coated must be scraped off to allow the pole piece, G, to touch the iron of the diaphragm. Between the diaphragm, H, and the cell, A, is placed a narrow cardboard ring, and above the diaphragm is placed another similar ring, both having an internal diameter corresponding with that of the diaphragm cell. Above the outer ring is placed a piece of wood, I, having an aperture of the same diameter as that of the diaphragm cell. Outside of this ring is placed a mouthpiece, J, which is beveled or concaved. The mouthpiece has a small central aperture, as shown.

The diaphragm, H, must be placed very near but not in contact with the pole piece, D, and so arranged that when the diaphragm is set in vibration by sound waves, it will not jar upon the pole piece. The mouthpiece, J, and the piece, I, are clamped to the diaphragm cell, A, by means of common screws, K, and the diaphragm cell, A, is clamped to the poles of the magnet, E, by the wooden crosspiece, L, and the screws, M, passing through the wooden crosspiece into the bottom of the diaphragm cell.

The ends of the fine wire on the spool, F, are uncovered and wrapped around the coarser naked wires, N, O, passing through the side of the diaphragm cell. Upon the outside of the cell, A, these coarse wires are bent into loops, and small wood screws, P, Q, pass through the loops into the side of the diaphragm cell, and upon each of these screws are placed two copper hurrs or washers, between which the ends of the line wires are clamped.

When two such instruments are connected together by means of two wires clamped by the screws, P, Q, as described, sounds uttered in one instrument will be reproduced in the other, and may be distinctly heard, although the volume is considerably reduced.

When a piece of

The arrangement of the line, and the theory of the working of the instrument, are given in connection with the telephone shown in Figs. 3 to 5 inclusive.

The instrument shown in these figures is a little more complicated than that shown in Figs. 1 and 2, but it is at the same time more effective.

For the construction of this telephone the following materials are required: A permanent horseshoe magnet of about the size shown in the engraving, an ounce of No. 36 silk-covered copper wire, two large common iron screws, such as are used in woodwork, a piece of thin tin plate, and some pieces of wood and small common screws.

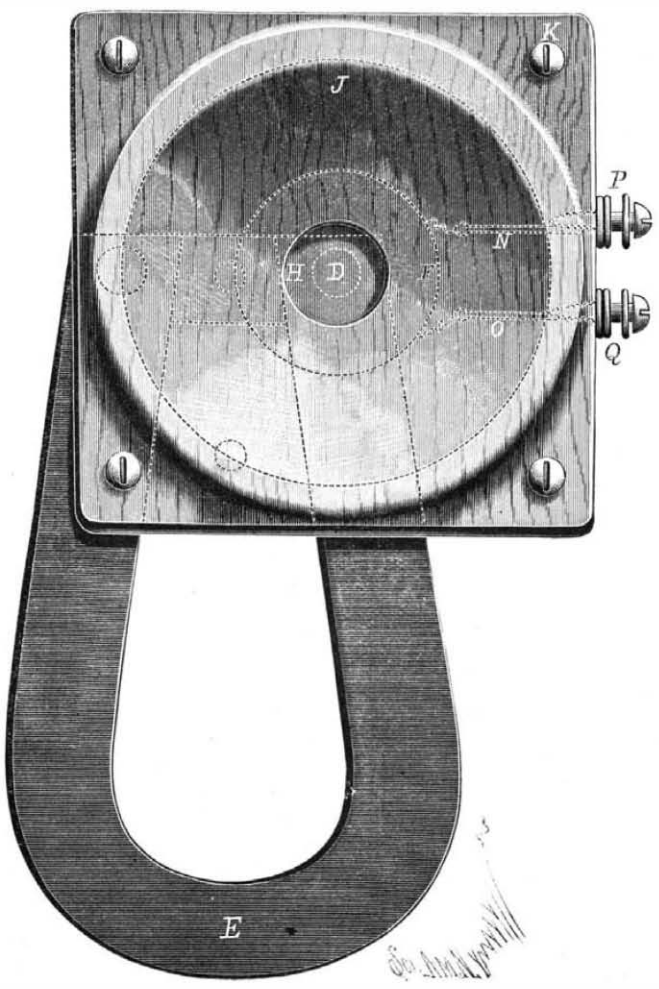

Fig. 3.—FRONT VIEW OF BIPOLAR TELEPHONE.

Fig. 4.—REAR VIEW OF BIPOLAR TELEPHONE.

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iron approaches the pole of a permanent magnet, it reduces the magnetism of that pole, and when the iron is removed from the magnet pole, the magnetism of that pole regains its normal strength. Faraday discovered that when the magnet is inserted into a coil of wire, it produces a momentary current in the coil in one direction, and when the magnet is removed from the coil, it produces a momentary current in the coil in the opposite direction. Any change in the magnetic condition of a piece of magnetic material contained in a coil produces a momentary current in one direction or the other in that coil. Now, by the vibration of the iron diaphragm of the telephone in front of the pole of the magnet, variations in the strength of the magnetism are produced in the pole, and this alternate increase and diminution of the strength of the magnet acts upon the coil surrounding the magnet core in exactly the same manner as if the magnet were introduced into and removed from the coil.

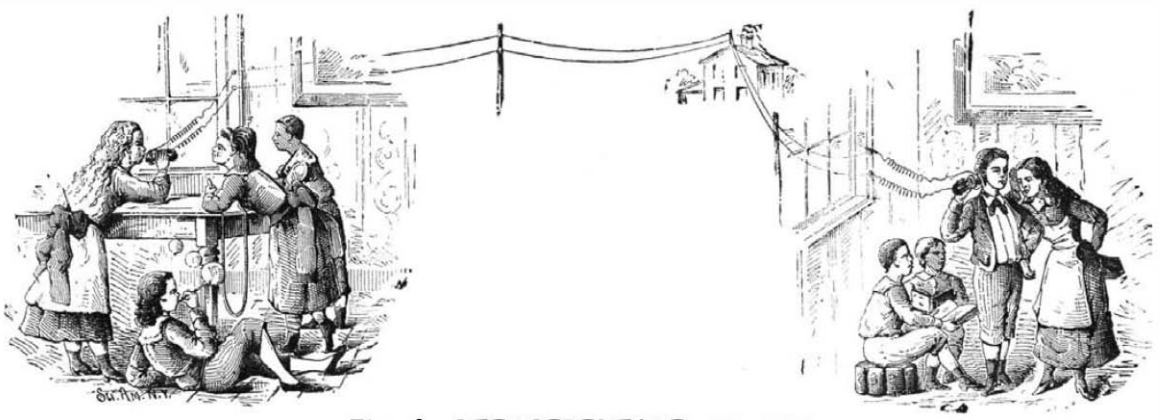


Fig. 6.—THE TELEPHONE IN USE.

The alternating currents thus generated in the transmitting telephone pass over the line and through the coil of the receiving telephone, and these impulses alternately increase and diminish the strength of the magnet in the receiving telephone so that its iron diaphragm is alternately attracted toward the pole of the magnet and then released, thus producing vibrations in the diaphragm of the receiving telephone which correspond to those of the transmitting telephone. These vibrations are imparted to the surrounding air, producing sounds like those uttered in the transmitting telephone. These instruments may be used interchangeably as receiver and transmitter. No battery is required, as no microphonic transmitter is employed.

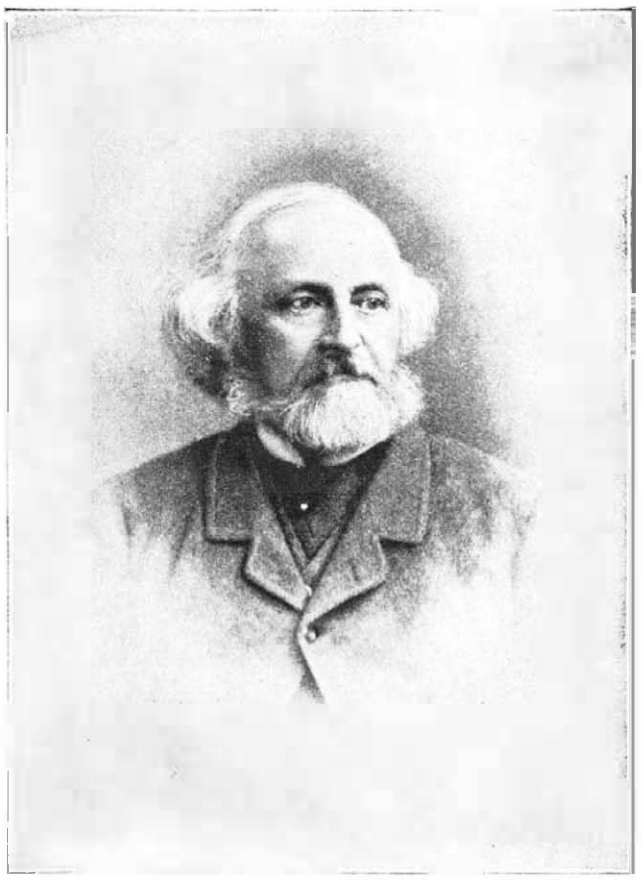
A single wire may be used to connect the screws, P, of the two instruments if the screws, Q, of the instruments are connected by a wire with a water pipe or a metallic ground plate two or three feet square, buried in earth that is constantly moist. In this case the circuit is completed through the earth. If the ends of the line wire are connected with the instruments by means of flexible conducting cords, the disagreeable jarring of the wires will be avoided. No. 12 galvanized iron wire or No. 16 copper wire will make a good line. The wire should be supported at intervals of 200 or 300 feet on glass or porcelain insulators.

The precautions necessary to observe in the construction of this instrument to insure success are briefly as follows: to secure a good contact between the pole pieces, D, G, and the poles of the magnet, and between the pole piece, G, and the diaphragm, H, to have the diaphragm perfectly flat and straight, to provide a perfect connection between the fine wire of the bobbin and the wires, N, O, running out of the diaphragm cell, to insulate the line wire conecting the two instruments, to have the diaphragm, H, as near the pole piece, D, as possible without danger of contact therewith, and to clamp the diaphragm by its edges in the cell in such a way as not to bend or buckle it.

The materials for the telephone may be obtained from any dealer in electrical supplies in any of our large cities and towns.

LEWIS MORRIS RUTHERFURD.

Most scientists pursue their vocation under the auspices of some college or public institution largely from two motives. First, because they are dependent upon the salary of such a place for their means of support, and secondly because the cost of scientific apparatus is usually so great that it prevents private ownership. Very few, for instance, could afford an equipment like that of the Lick Observatory, in California, or an outfit similar to that possessed by the Jefferson Physical Laboratory, of Harvard University. A notable exception to this rule, and by far the most distinguished private scientist in the United States, is the gentleman whose career is herewith described.



LEWIS MORRIS RUTHERFURD.

Mr. Rutherfurd was born in Morrisania, N. Y., on November 25, 1816. He comes of distinguished lineage, for his grandfather was John Rutherfurd, twice elected to the United States Senate from New Jersey, serving from October, 1791, till February, 1798. Senator Rutherfurd's father entered the British army at the age of seventeen, and after taking part in the Canadian campaign, under Sir Jeffrey Amherst, resigned his commission, married a daughter of James Alexander (thus making him a brother-in-law of Lord Stirling), and became a citizen of New York. The senator was educated at Princeton, and studied law. After his admission to the bar he married a daughter of Lewis Morris, and continued in New York City until 1787, when he removed to New Jersey.

His grandson, the subject of this sketch, is the son of Robert Walter Rutherfurd and Sabina Elliott Morris, and was graduated at Williams College, in 1833. Selecting law as the profession which he proposed to follow, he studied under Governor William H. Seward (afterward Secretary of State in President Lincoln's cabinet) in Auburn for two years, and then in New York City with George Wood, who was at that time one of the foremost lawyers in the country. As Mr. Wood persistently refused public office, his name has been almost forgotten, but the following anecdote shows the esteem in which he was held by his contemporaries: When William C. Preston, of South Carolina, was about to argue an important case in the United States Supreme Court, Daniel Webster asked him who was on the other side. Preston replied that it was a man from New York, whose name he could not recall, and said, "A sleepy-looking fellow named Wood, I think." "If it is George Wood," said Webster, "I advise you to look out how you wake him up." Such were Mr. Rutherfurd's legal instructors, and he was equally fortunate in his associates in practice.

In 1837 he was admitted to the bar of the New York State courts, and entered into partnership with Peter Augustus Jay, the son of the Chief Justice who administered the oath to President Washington, in 1789, with whom he continued until Mr. Jay's death, in 1842, and then he became associated with Hamilton Fish, who was afterward Secretary of State in President Grant's cabinet. Mr. Rutherfurd continued in active practice until 1849, when he went to Europe, remaining abroad until 1852. On his return he did not resume his profession, but thereafter devoted his leisure to studies in astronomy and optics. He erected an observatory in the garden of his residence, at 175 Second Avenue, on the corner of Eleventh Street, New York City, and there did his principal scientific work.

One of his earliest contributions was concerning the "Companion of Sirius,"* whose discovery had just been announced by Alvan G. Clark, the well known maker of telescope lenses. Mr. Rutherfurd corroborated its existence, and says: "Since hearing of the existence of this star I have never looked for it in vain. Its difficulty is not occasioned by faintness, but by its proximity to so bright an object as Sirius. I consider it decidedly a brighter star than either of the close companions in the trapezium of Orion; no reasonable amount of illumination in the field extinguishes it."

In December, 1861, at the suggestion of Dr. Wolcott Gibbs, he began a series of experiments with the view of determining the best form of instrument for the purpose of continuing Fraunhofer's observations upon the spectra of the heavenly bodies. He adapted Bunsen's and Kirchhoff's simple form of spectroscope, consisting of a condensing telescope with adjustable slit, a scale telescope with photographed scale of equal parts showing bright lines upon a dark ground, a flint glass prism of 60°, and an observing telescope with Huygenian eyepiece, magnifying about five times, the whole firmly but lightly mounted on seasoned wood and provided with an adapting tube in front of the slit, by means of which the spectroscope is attached to the eye-tube of the equilateral. A year later he published his results* in a paper, giving the fixed lines exhibited by the moon; also the lines and bands of Jupiter and Mars, with maps of the spectra of seventeen of the fixed stars, and including a full description of the instruments that he used.

This was the first work to be published after the great revelations of Bunsen and Kirchhoff, and was the first attempt to classify the stars according to their spectra. While Mr. Rutherfurd was engaged in making these researches on the spectra of the stars, he discovered the use of the star spectroscope, by means of which it is possible to show the exact state of achromatic correction in an object glass, and is particularly adapted for the rays that are used in photography.

In 1864, after many experiments in various directions, but all undertaken for the same purpose, he succeeded in devising and constructing an objective of 11¼ inches aperture and about 15 feet focal length, corrected for photography alone. This instrument was a great success, and was described by him in the *American Journal of Science*.† It was constantly used by him in making negatives of the sun, moon, and star groups.

At the January meeting of the National Academy of Sciences, in 1864, he presented a paper "On Photographs of the Solar Spectrum," accompanied by a picture that he had taken by means of bisulphide of carbon prisms. It contained more than three times the number of lines that had been laid down within similar limits on the charts by Bunsen and Kirchhoff.

He also was the first to show the double character of the D sodium lines in the spectrum, finding that "is resolved into fourteen fine and close lines, with a beautiful and symmetrical band of finely doubled lines stretching toward A."

About the same time he published criticisms on different forms of spectroscopes that had been used by Secchi, Airy, and Donati, and in 1865 produced an automatic form of a six-prism spectroscope, which still continues the best in use.‡

In 1868 he built a new objective, with 13 inches aperture and about 15 feet focal length. This glass was an ordinary achromatic, such as is used for vision, and was converted into a photographic objective by the addition of a third lens of flint glass, which made the proper correction, and could be affixed in a few minutes. With this instrument Mr. Rutherfurd made several photographs of the moon that are of remarkable beauty, and have never been surpassed in delicacy or exactness. One taken on Feb. 27, 1871, is stated by Warren de la Rue to be the finest in existence.

He constructed a micrometer for the measurement of astronomical photographs for use upon pictures of solar eclipses or transits and upon groups of stars, of which he has measured several hundred, showing, as it is claimed by him, that the photographic method is at least equal in accuracy to that of the hellometer or filar-micrometer, and far more convenient. It was suggested by a German writer that the collodion film was unreliable, and Mr. Rutherfurd published a series of measurements that demonstrated conclusively its fixity under proper conditions.§

In 1870 he constructed a small ruling engine, which produced inference gratings on glass and speculum metal that were superior to all others until the recent

*Am. Jour. Sci., 2 series, vol. 34, p. 394. 1862.

*Am. Jour. Sci., 2, vol. 35, p. 71. 1863.

†"On Astronomical Photography," 2 series,—vol. 39, p. 304. 1865.

‡"On the Construction of the Spectroscope," *Am. Jour. Sci.*, 2, vol. 39, p. 129. 1865.

§"Stability of Collodion Films," *Am. Jour. Sci.*, 3, vol. 4, p. 120. 1872.

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productions of Prof. Henry A. Rowland, of the Johns Hopkins University. With one of these gratings he obtained a photograph of the solar spectrum that for a long time was unsurpassed.

He published, in 1876, a paper on "Glass Circles for Measuring Circles,"* in which he described an instrument in which the divided circle was of glass, and showed by readings that it gave a far greater accuracy than could be obtained from divisions on metallic circles of the same dimensions.

In 1883 failing health led to the discontinuance of his scientific work, and in December of this year he presented his astronomical instruments to the observatory of Columbia College, where they are mounted.

These included a large equatorial refractiug telescope, with an object glass of 13 inches and focal length of 15 feet, supplied with photographic correcting lens made after his own design; a transit instrument made by Stackpole & Brother, of New York City, for observations of time; likewise micrometers for use with the large equatorial and a special micrometer for measuring photographs, which had been for several years in the possession of Benjamin A. Gould, of Cambridge, and was used by him in measuring up his photographs; also a very fine sidereal clock, made by Dent, of London, and a cistern bar made by Green, of New York.

With these instruments he included a gift of sufficient money to defray all expenses necessary for their transportation and mounting in the Columbia Observatory. The value of this benefaction is estimated at $15,000.

In 1858 he was elected a trustee of Columbia and continued as such until he resigned in 1884. The degree of LL.D. was worthily conferred on him by this institution at its centennial celebration in 1887.

Mr. Rutherfurd was appointed by the President of the United States to be one of the American delegates to the International Meridian Conference held in Washington, D. C., in October, 1885, and he took an active part in the work, and framed and presented the resolutions that finally expressed the conclusions of the conference. He was invited by the French Academy of Sciences to become a member of the International Conference on Astronomical Photography, held in Paris in 1887, and was appointed by the president of the National Academy of Sciences as its representative to that meeting, but was obliged to decline on account of failing health.

He was one of the original members named in the act of Congress, in 1863, creating the National Academy of Sciences, and has been a member of its council, and has served on various committees. In 1857 he was elected to membership in the American Association for the Advancement of Science, and in 1875 was advanced to the grade of fellow. He has been a corresponding member of the Academy of Natural Sciences, of Philadelphia, since 1859, and a member of the New York Academy of Sciences since 1864. Besides membership in various other scientific bodies, he is an associate of the Royal Astronomical Society, of Great Britain, and his work has been recognized by the gift of various diplomas, orders, and medals, both at home and abroad.

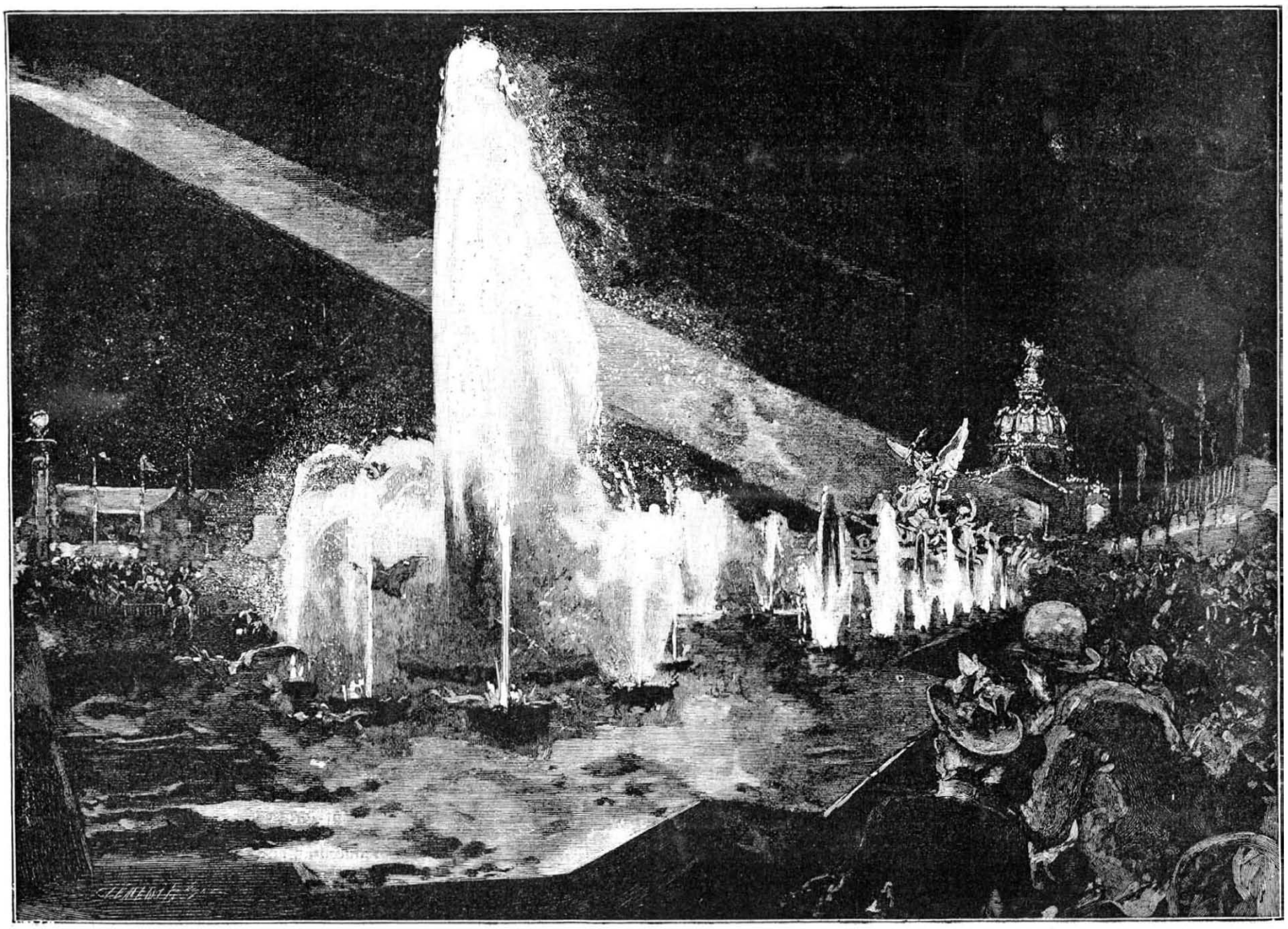
THE LUMINOUS FOUNTAINS AT THE FRENCH EXPOSITION.

Among the most wonderful displays, electric and visual, at the recent French exposition were those pertaining to the luminous fountains, which were arranged on a grand scale and occupied a large portion of the plateau in front of the main entrance. The chameleon-like changes of color in the fountain waters were something astonishing to behold. It was not accomplished by the mere throwing of colored lights upon the exterior of a spouting jet, but was due to an interior electric illumination of the molecules of the water; the beams of light being, so to speak, thrown into and imprisoned within the crystal walls of the water and then carried along with it, becoming visible by interior reflection during the discharge of the water.

We give from *Le Monde Illustre* a spirited drawing of these remarkable fountains as they appeared during the grand illumination in honor of the closing of the exhibition, on the evening of November 6 last, and we subjoin additional illustrations showing the particular *modus operandi* whereby the illumination of the fountain jets was effected.

As the exposition was to open at night, it became necessary to find, aside from the enchanting illumination that it was proposed to have there, an attractive novelty worthy of figuring among so grand surroundings during the evenings of the exhibition. It was then that the luminous fountains were thought of that had so great a success at London, Manchester, and Glasgow.

First is the monumental fountain representing the ship of the city of Paris, ornamented with horns of plenty and with dolphins, from which issues water that, falling into a vast basin, afterward falls in a cascade, 130 feet in width, into a lower basin in communication with a rectangular basin 130 feet in length, forming the second piece of water. Finally, the water reaches an octagonal basin ornamented with 17 wheat-sheaf jets (Fig. 1). We shall not speak of the details of construction and of the obstacles that had to be overcome in the progress of the work, but shall proceed to describe the structure of the jets through which the water and light issue. In the upper basin, the water escapes through four horns of plenty, four dolphins, and six urns, forming together fourteen parabolic or horizontal jets; then two vertical jets, each placed on the side of the vessel. On the edge of the rectangular basin there are fourteen wheat-sheaf jets, two of which are placed in the lower basin. Each of these consists of seventeen jets of small size so arranged as to cause the water to fall back in a spray around the vertical jet that escapes from the central part. Finally, the octagonal basin consists of two rows of concentric vertical jets—the first comprising six and the second ten jets. In the center is placed an immense double wheat-sheaf jet.



CLOSE OF THE FRENCH EXHIBITION—THE LAST PLAY OF THE LUMINOUS FOUNTAINS, NOVEMBER 6, 1889.

As may be seen, the whole consists, then, of thirty-three vertical and fourteen parabolic jets, forming nearly three hundred tubes, from whence the water escapes at the rate of 88 gallons per second, supplied by Seine water derived from the Villejuif reservoir, situated at an altitude of about 290 feet.

As for the lighting, that is effected by 17 arc lamps (with a 60 ampere current) in the English part of the octagonal basin and by 30 regulators (with a 40 ampere current) in the rest of the fountain, including the French portion. The motive power absorbed by this lighting is of 250 horses. Subterranean galleries extend under the entire piece of water, and form a true crypt, in which are placed the electric lamps and the whole arrangement for producing the variation in colors.

If in the subterranean chamber we place the arc lamps, each provided with a reflector, under a glass plate, we obtain a vertical luminous pencil formed of sensibly divergent rays, which envelop the liquid mass of the jet as well as the water that falls back in drops.

The regulator, or lamp, whose carbons are vertical, is regulated automatically; then, for the tin reflector, silvered glass mirrors are substituted, one of which,

Am. Jour. Sci., 3, vol. 12, p. 112. 1876.

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spherical in form, receives the rays of the arc lamp and concentrates them horizontally upon another and plane mirror inclined at an angle of 45°, which, in turn, sends them vertically into the jet. A glance at Fig. 2 will allow the operation of this arrangement to be understood.

We now come to the lighting of the parabolic jets that escape from the dolphins, etc.

After laborious researches, Mr. Bechmann, assisted by Mr. Richard, found the solution by converting the solid jet into an annular one, into the center of which a luminous fascicle was projected. This was done as illustrated in Figs. 3 and 4. The water escapes through the annular space and forms a hollow jet, through which the luminous fascicle is sent by a mirror inclined at an angle of 45°, placed in front of the cone and receiving vertically the light.

This arrangement permits of illuminating a jet of water 8 inches in diameter and of a height of fall of 14¾ feet. What is particularly remarkable is that not a ray escapes from the liquid, and that the fascicle of light is totally reflected over the entire curve of the jet, on condition, however, that the latter be not broken by anything, such as a blast of wind or a foreign body placed in the annular space.

What precedes gives a sufficient idea of the lighting. We shall now have a few words to say about the variations in color and the maneuvers they necessitate. The various tints given to the jets are obtained by simply interposing colored glass between the luminous source and the jet of water; in a word, the rays are passed through differently colored plates of glass forming a gamut of five tones. These plates are superposed in a frame fixed to the vault of the gallery, as may be seen in Fig. 3.

We shall now briefly describe the principle of the

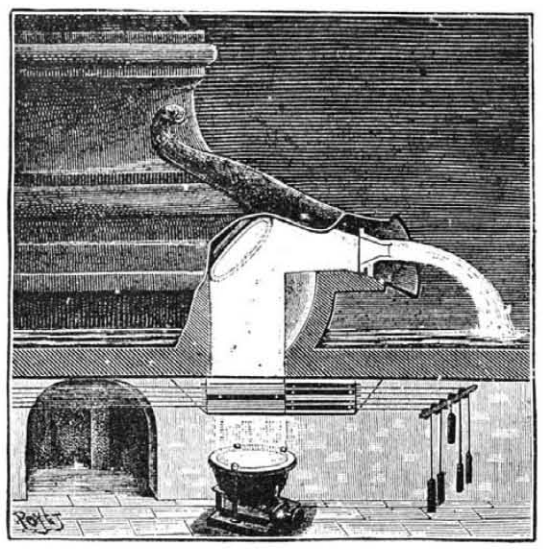

Fig. 3.—ILLUMINATION OF PARABOLIC JETS OF WATER.

maneuver. All the glasses of the same color are connected with each other in series of five by means of a cable of small section passing, at the angles formed by each change of direction, over movable pulleys, and ending at a lever (see Fig. 5), to which it suffices to give a backward and forward motion of from 20 to 30 inches in order to bring the glasses in front of the luminous sources or to replace them in the frame. Each frame that carries the glasses is placed upon wheels that run upon rails, and is provided besides with a lattice work of very fine wire and with large meshes, in order to prevent the pieces from falling upon the mirrors in case a glass breaks.

As regards the maneuvering of the whole, that is directed by a foreman in a kiosk situated at 95 feet from the fountain and corresponding through a gallery with the octagonal basin. From this kiosk, whence

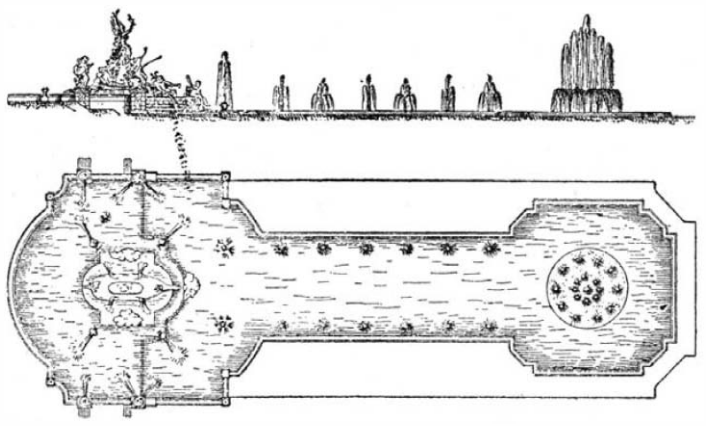

Fig. 1.—SECTION AND PLAN OF THE LUMINOUS FOUNTAIN OF THE PARIS EXPOSITION.

he judges of the effect, the foreman controls the plays of water and light; the first through levers that he himself maneuvers, and the second through a series of electric buttons that communicate with the subterranean chambers and indicate to the men the colors that are to concur in the general effect.

Fig. 5 represents the interior of one of these chambers, situated under the principal group. In the center are placed the maneuvering levers, and above them is seen the annunciator on which the orders for the colors to be shown are given electrically.

To the left is perceived a part of the frame that supports the four regulators which light the horns of plenty on each side of the vessel. To the right, between the doors of the lateral galleries, in which are placed the regulators and mirrors that light the jets bordering the rectangular basin, figure the electric measuring apparatus.

When we shall have said that the entire mechanism

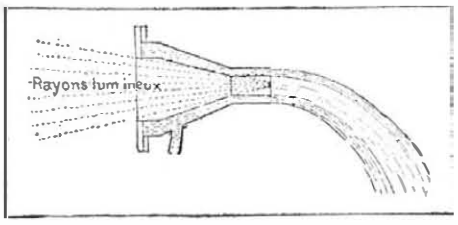

Fig. 4.—NOZZLE FOR PARABOLIC WATER JETS.

that we have just described operated with perfect regularity, producing surprising and admirable effects, with which are joined the fires at the summit of the Eiffel tower, lighting the group of the Genius of France, borne on the vessel of the City of Paris, and overthrowing Routine and Ignorance on each side, while at the prow of the ship the Gaulish cock sings the success of the exposition, and while at the poop the Republic directs the rudder, we shall have said everything about the fountains, which are as marvelous as they are luminous.

We cannot finish without citing the names of those who, in the different parts of this work, have shown a remarkable activity, an extensive knowledge, and a talent beyond comparison, and to whom we are happy to render homage by addressing our thanks to them for the courtesy that we always met with during the electric installation that we had charge of; they are Messrs. Alphand and Berger, the organizers; Mr. Hippolyte Fountaine, the promoter of electric lighting *par excellence*; Mr. Formigi, the architect; Messrs. Bechmann and Richard, whom we have already mentioned, and who directed the arrangement of the fountains; Mr. Meker, the inspector who superintended the central shops of the lifting machines of the city of Paris, assisted by Mr. Dallard, foreman in the construction of the apparatus; and finally, the sculptor Coutan, who crowned the work by a composition whence emanate all the grace, flexibility, elegance, and vigor of French art, from which he has borrowed with his whole soul, contrary to the practice of some artists of too often imitating Greek art as soon as it becomes a question of allegories.

Finally, all have given proof of an indefatigable ardor, all feeling the importance of the work that they were doing; all, the workmen included, have had but one end in view—the success of the exposition, for such success is the triumph of the genius of France.—*D. Napoli, in La Nature.*

Virginia Mincemeat.

The wife of Gov. Fitzhugh Lee, of Virginia, is a famous housekeeper, and this is how she says she makes the mincemeat for her Thanksgiving pies: Two pounds beef, two of currants, two of raisins, one pound of citron, two of beef suet, one and a half of candied lemon peel, four pounds apples, two of sultana raisins, two of sugar, two nutmegs grated, quarter ounce cloves, half ounce cinnamon, quarter ounce mace, one quart sherry or good home-made currant wine, one quart good brandy, one teaspoonful of salt, the juice and rind of two lemons and two oranges. Simmer the meat gently till tender, and when perfectly cold chop it fine. Stone the raisins, shred the citron, pare, core, and chop the apples, chop the suet fine. Mix the dry ingredients together, then add the juice and rinds of the oranges and lemons. Pack in a stone jar, pour on the wine and brandy, cover close, and keep cool. This mincemeat will keep all winter. When wanted for pies, thin with cider or wine. The rule is an old one, and is said to have come from the Custis family in the beginning. According to Virginia tradition the Widow Custis, who became Mrs. Washington, made famous mince pies.

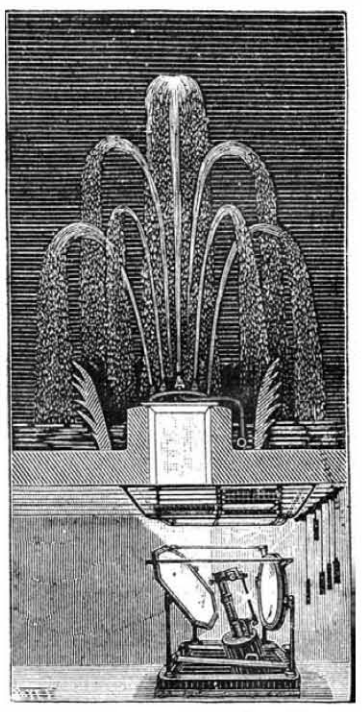

Fig. 2.—FRENCH SYSTEM OF ILLUMINATING WATER JETS.

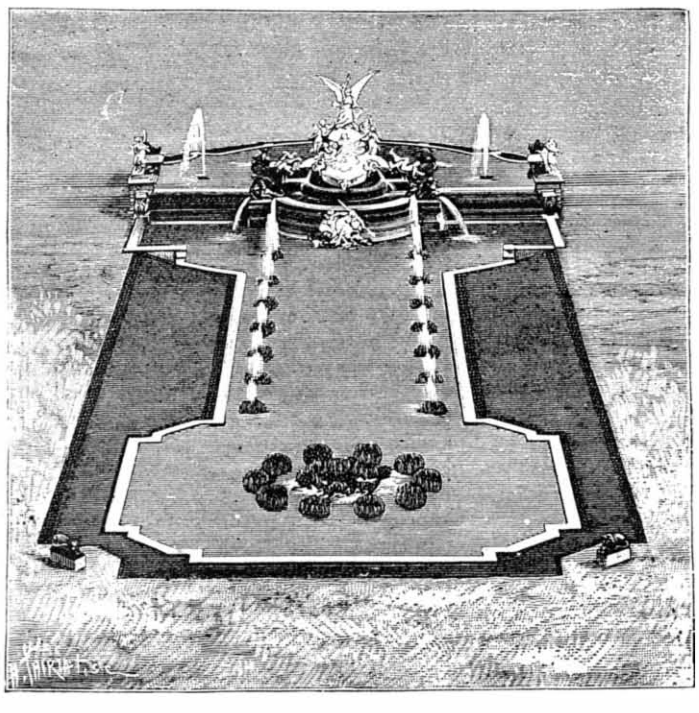

Fig. 6.—BIRD'S-EYE VIEW OF THE LUMINOUS FOUNTAIN.

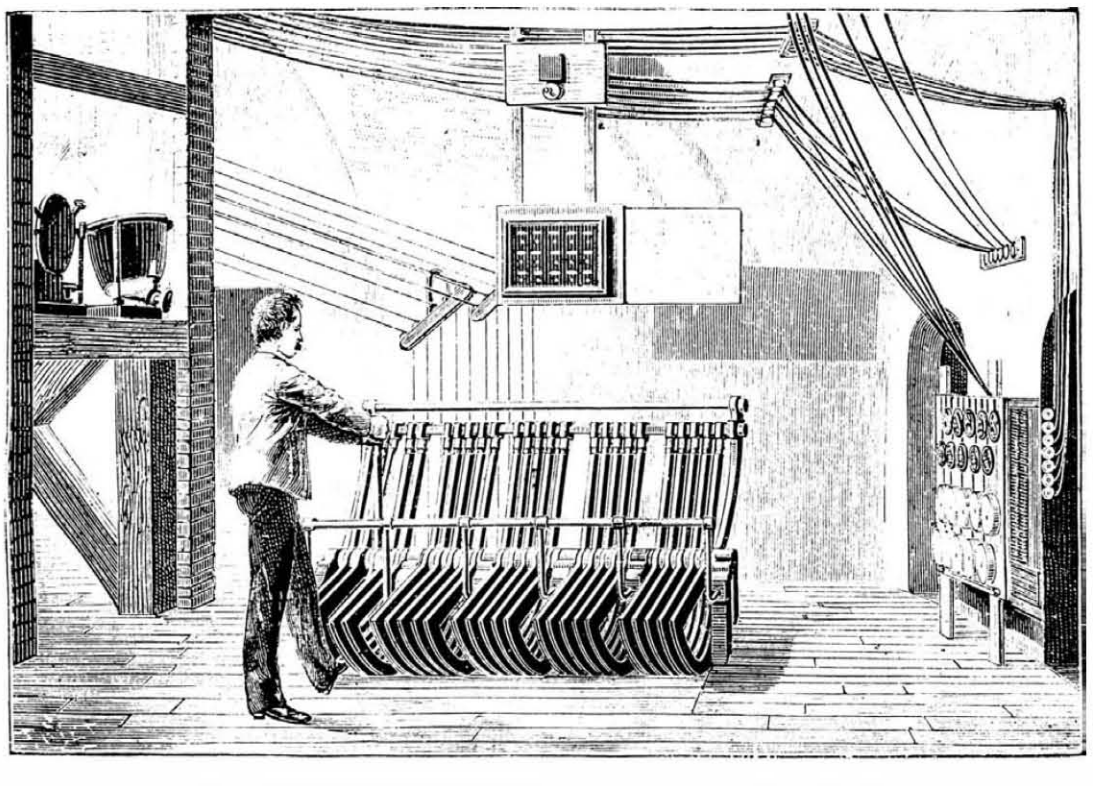

Fig. 5.—SUBTERRANEAN CHAMBER OF THE LUMINOUS FOUNTAIN.

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RECENTLY PATENTED INVENTIONS.

Engineering.

PETROLEUM MOTOR ENGINE. — Karl Gramm, Berlin, Germany. This invention provides a novel apparatus by which the explosive mixture is produced and introduced into the cylinder of the engine by causing a jet of air to take up a certain quantity of petroleum, which mixes in the form of a spray, the mixture being then carried into the heated cylinder.

Railway Appliances.

CAR STARTER. — Samuel J. Pearsall, Saratoga Springs, N. Y. A toothed wheel on which are pivoted spring pawls is held loosely on one of the axles, and a ratchet wheel is secured to the axle, a sprocket chain engaging the toothed wheel, and a spring connected at one end to the sprocket chain and at its other end to the car, whereby power may be stored up by the operator on the platform as desired, to be utilized when needed in starting the car.

DOG FOR LOG CARS. — Robert J. Thompson, Grandin, Mo. This is an attachment in which a series of dogs is arranged to be raised or lowered simultaneously, and the dogs upon either side of the body may be manipulated independently, whereby logs may be effectually retained in position on the body of a car or wagon or other log carrier, and expeditiously released therefrom at the proper time.

CAR JOURNALS. — James K. Hardwicke, Marshall, N. C. This is a device for automatically oiling and cooling journals and bearings, and automatically cleaning them from gum or other matter in case of overheating, a reservoir with valve communicating with the journal box, and an operating mechanism extending outside of the box to be operated at stated intervals by projections along the roadway.

Mechanical.

PLANE. — Wilhelm Meister, Apolda, Saxe-Weimar-Eisenach, Germany. This is a carpenter's plane in which the bit opening extends part way toward the top of the stock, and through its sides for the escape of shavings, the bit having a slot open at the rear end, and a bed plate, clamping plate and screws, the latter having heads with cross slots, making a plane in which the bit will be effectively held from slipping.

TOOL HOLDER. — Henry Schoncke, Oceanus, N. Y. This is a holder specially designed for holding a tool in proper position for grinding on a wheel, and has standards, forwardly projecting tool holder arms, a T-shaped spring with its transverse arms bearing upon the arms, a cross piece connecting the standards above the spring, and a set screw projecting through the cross piece against the upper side of the spring.

TOOL. — John L. Painter, Bellevue, Ohio. This is a combination implement comprising a series of wrenches of different sizes, each capable of independent use, a wire cutter, pliers, and a screw driver, the tool being especially adapted for use in connection with self-binding harvesters and similar machines, and being simple in construction and capable of easy manipulation.

BELT CARRIER.—Thornton M. Nichols, Lexington, Mo. This invention provides a belt-carrying frame adapted to be held on the rim of the wheel or pulley, a clamping mechanism being held on the frame and adapted to engage and release the rim of the wheel, being a simple and effective device for conveniently placing the belt on the pulley.

GUDGEON FOR SAND REELS.—William Richards, Mayburg, Pa. This is an improved gudgeon for drilling machine sand reels, and is light and durable and designed to prevent the ends of the tubular reel shaft from splitting, the gudgeon being held locked to the shaft under the severest pressure upon the friction pulleys of the reel.

PICKER CHECK FOR LOOMS. — Robert Whitehouse, New York City. This is a check or bunter having an elastic cushion, and capable of ready attachment to and detachment from a loom, whereby the shock or concussion from the contact of the shuttle with the picker will be largely reduced, and the shuttle binder need not be so tightly adjusted as heretofore.

WINDMILL. — James E. Duncan, Forman, North Dakota. This invention consists of a horizontal windwheel turning loosely in an apertnre formed in the bottom of a casing mounted to turn, and provided with an adjustable inclined cover for guiding the wind to the wheel, the construction being simple and durable and very effective in operation.

PRINTING AND RULING MACHINE.—James W. Dickieson, Brooklyn, N. Y. This invention combines a printing press with a ruling machine in such manner that the press constitutes the feed of the ruling machine, the paper being first printed and then ruled, whereby it is designed to produce work superior to that which can be done when the paper is first ruled and then printed.

BENDING VEHICLE SHAFTS.—Thomas E. Montague, West Lorne, Ont., Canada. This invention relates to machines for bending the shafts or thills of carriages or other vehicles, and covers improvements on a former patented machine of this class of the same inventor, whereby the machine is made more simple and automatic, enabling the shafts to be bent with greater economy of time and labor.

Miscellaneous.

SASH FASTENER. — Henry P. Bulloch and William L. Grogan, Jonesborough, Texas. Combined with the upper and lower sashes is a spring secured to the lower sash and provided with a friction roller on its free end engaging the upper sash, permitting of conveniently raising and lowering the sashes and holding them at any desired place in the window frame.

EXTENSION MATTRESS. — Edwin R. Weber, New York City. This mattress has flexible longitudinal metallic strips connected by metallic cross strips and extensible end portions, consisting of elastic V-shaped brace strips, with other novel features, whereby the mattress may be extended or shortened without interfering with the springs, will be firmly braced at the ends, and may be rolled up.

MOSQUITO CANOPY.—Harriet B. Kip, Morristown, N. J. The head plate is made in two sections, hinged together at the side flanges and adapted to fold one on the other to form a box to receive the netting fabric, the apparatus being designed to fold in very small space for convenient transportation, and to be readily unfolded and set up for use over a bed, sofa, or chair.

HOOP STAY FOR BUCKETS, ETC.—William S. Pollitt, Crested Butte, Col. Combined with the vessel is a stay consisting of a strip of metal having brackets arranged in pairs projected from the outer face, with other novel features, for retaining the hoops in proper position should the wood shrink, and whereby the hoops may be tightened when desired, in a convenient and expeditious manner.

GAUGE FOR LANTERNS.—Eugene D. Scribner, Northville, N. Y. In the side of and in communication with the oil reservoir a metal tube is secured, and in this tube is secured a glass tube, whereby the amount of oil in the reservoir may at all times be accurately ascertained, so that in filling the danger of overflowing the lantern at the opening may be avoided.

COVERED CART. —Philip Bourne, No. 748 Monroe Street, Brooklyn, N. Y. This is a cart which is necessarily closed when the driver stands upon the foot board, the cart body being provided with hinged covers or lids and a sectional movable foot board, the connections being so arranged between the foot board and the covers that when the foot board sections are pressed down the covers will be closed, preventing the blowing away or the losing of any of the contents of the cart.

SCIENTIFIC AMERICAN BUILDING EDITION.

DECEMBER NUMBER.—(No. 50.)

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2. Plate in colors of $1,500 cottage. Floor plans, perspective elevation and details.
3. View in colors of the residence of C. W. Miller, Esq., Tompkinsville, N. Y. Cost about $20,000. Plans, elevations, details, etc. E. A. Sargeant, architect.
4. Colored plate of the residence of E. Bridgeman, Esq., Staten Island, N. Y. Cost about $18,000. Floor plans, elevations, etc. E. A. Sargeant, architect.
5. A cottage erected at Larchmont Manor, N. Y., at a cost of $1,500 complete. Perspective elevation and floor plans.
6. The new Bourse or Commercial Exchange at Paris, designed by M. Berteault; interior and exterior views. Cost $1,400,000.
7. A cottage recently erected at Larchmont Manor, N. Y., at a cost of $3,000. Floor plans and perspective. Architect W. Holman Smith, New York.
8. Cottage at Larchmont Manor, N. Y., erected at a cost of $4,500 complete. Floor plans and perspective. Architect Henry Kilburn, New York.
9. A very attractive cottage at Iselin Park, New Rochelle, N. Y., at a cost of $3,400 complete. Plans and perspective.
10. Residence at Holyoke, Mass. Cost $5,500 complete. Perspective elevation and floor plans.
11. Engraving and ground plan of a church at Rutherford, N. J.
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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(1614) G. E. H. asks: 1. Would electric light carbons arranged in the form of a cylinder, or twelve of them in a bunch, make the carbon element for a plunge battery? A. Yes. See SCIENTIFIC AMERICAN, Oct. 27, 1888, and Dec. 17, 1887. 2. I have several hundred of the carbons not copper-plated. I am making a twelve-cell battery, and propose to use 12 carbons in cell. What will be the number of volts per cell, and what candle power light would it run? A. About 2 volts per cell. You can probably run one sixteen candle lamp for two or three hours. 3. How long would a sal-ammoniac battery run with a carbon and zinc element and no depolarizer? A. It would work for a few minutes at a time. 4. How can I prepare a wood cell for a plunge battery, to take the place of glass? A. A cell made of dry pine, well saturated with paraffin, answers very well. 5. Would one ounce of No. 18 and four ounces of No. 36 copper wire make an induction coil large enough for practical purposes in medicine? A. Yes.

(1615) S. B.—There is no absolute distinctive mark for the ecliptic boundaries of the zodiacal constellations further than the general assignment of 30° each, commencing at the vernal equinox as it existed about 2,150 years ago. The precession of the equinoxes in the mean time has carried the constellation back about 30°, so that the vernal equinox is now in the first point of the constellation Pisces.

(1616) A. B. asks: 1. Will cast iron rings answer for the armature of the 8 light dynamo? A. No. 2. What is the base of the machine composed of? A. Wood. 3. Can No. 12 double-covered wire be used to convey the current a distance of 150 feet? A. Yes; but office wire would be better.

(1617) C. T. asks: What heat is required to bake chinaware after painting? A. A strong red to orange heat.

(1618) Beaker writes: Will you state the length of German silver wire for the resistance of one ohm No. 26 American wire gauge at the temperature of 70 degrees Fahrenheit, and also the increase in resistance for each degree (Fah.)? A. Approximately 1·794 feet. Its change per degree Centigrade may be calculated from following formula:

$$R = r(1 + at + bt^2)$$

in which R = resistance at $t°$, r = resistance at 0° C., and a = 0·0004433 and b = 0·000000152.

(1619) T. H. writes: 1. There is a spring on one of the tributaries of the Allegheny River which when the sediment in the bottom is agitated becomes luminous like a friction match when damp. Are such springs known elsewhere? Is there such a thing as phosphorus in a mineral state? A. It is undoubtedly due to organic matter in a state of decay, being the same phenomenon as presented by decaying wood or putrefying fish. Similar manifestations are quite common, but phosphorus has nothing to do with most of them. It does not occur in the free state in nature. 2. Does distilling water purify it? I once heard a distiller say that any foreign matter with a strong odor put in a doubling still would show itself, both in taste and smell, in the liquor. A. Yes; from non-volatile matter; the distiller was right, as volatile matter goes over with the distillate, and to some extent is recondensed or reabsorbed in it. 3. Is rubber in making shoes put on the mould in a hot or melted state? A. It is vulcanized in place. See our SUPPLEMENT, Nos. 249, 251, and 252, for lectures on India rubber. 4. Why will not red hot or a hot coal ignite illuminating gas? A. The heat is not intense enough when it fails to ignite gas.

(1620) H. A. A. writes: 1. Is there any preparation that will turn the hair gray without injury to the scalp or the texture of the hair? A. Binoxide of hydrogen will bleach hair, and if properly applied need not do permanent injury, though it might affect the follicles to some extent. It is sold under various names, as hair bleach, etc. 2. Where can I get a dictionary of electrical terms and phrases? A. We can supply you with Houston's Dictionary of Electrical Terms for $2.50 by mail.

(1621) G. R. C. asks: 1. Is there such a thing as noiseless gunpowder, and if so, upon what theory is the fact of there being no noise (or very little noise) explained? A. There is no such thing. It is easy to understand that there may be a difference in noise or detonation, and a more perfect powder may be less noisy than a cruder preparation. 2. How may glass disks of ordinary window glass be punctured to fit a shaft or mandrel? A. By a tube of copper guided in a frame and turned by a common brace, its edge being fed with emery and oil. A cork cemented with sealing wax to the glass and fitting the interior of the tube may be used to center it.

(1622) E. M. S. — Pot-pourri is a mixture of dried petals of roses, violets, etc., mixed with 1-10 its weight of salt. The leaves of fresh roses, etc., are collected and dried on porous paper in the sun; as soon as dry they are placed in a jar in layers alternating with the salt. Powdered orris root and extracts and many other ingredients may be added according to taste.

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AND EACH BEARING THAT DATE.

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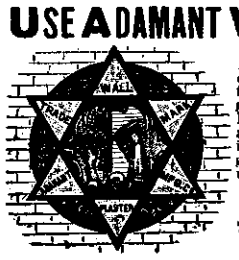

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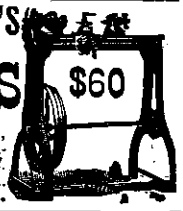

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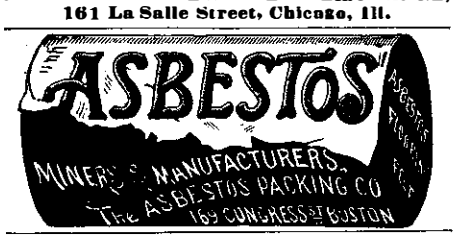

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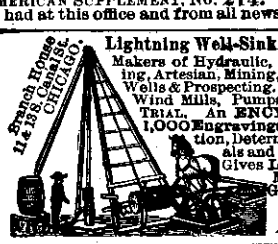

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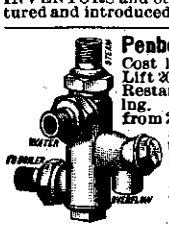

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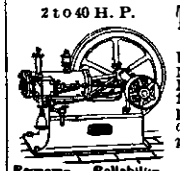

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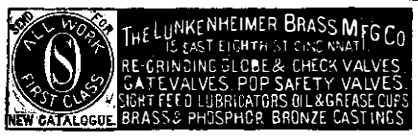
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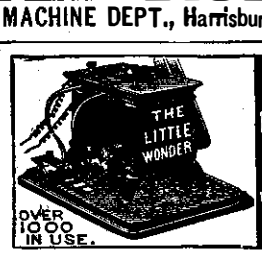

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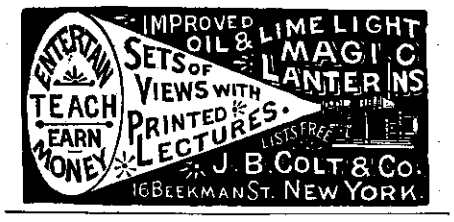
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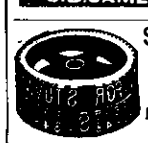

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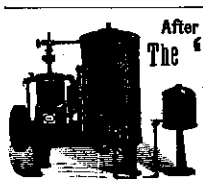

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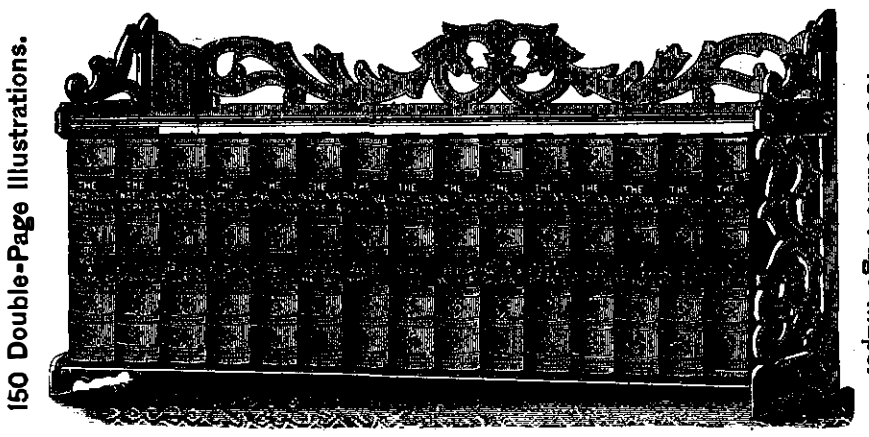

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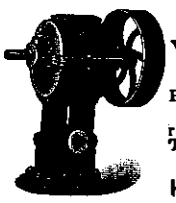

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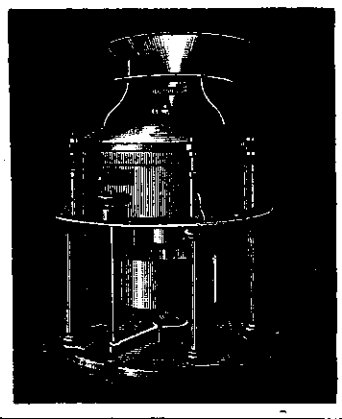

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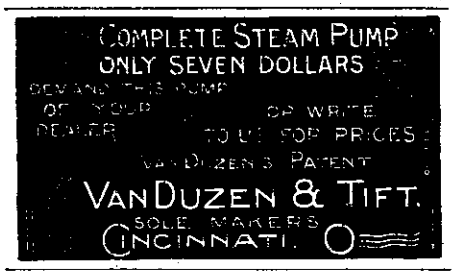

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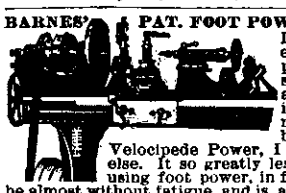

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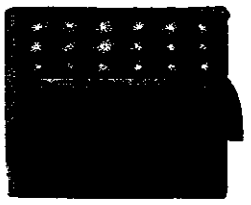

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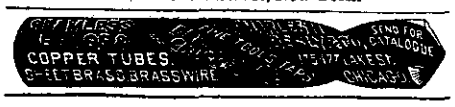

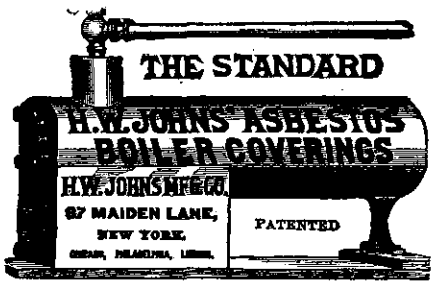

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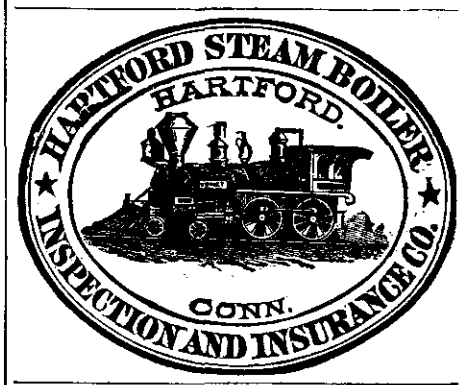

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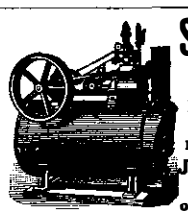

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